NOVEMBER 1968 50 CENTS

# Popular Science

MONTHLY

## 16-page special: Antifreeze FOR YOUR CAR

Facts you need to know to keep your cooling system healthy the year around

Now This Is

## REALLY FLYING!

see page 63

AUTEC: Our Secret Undersea Test Range for Anti-Sub Weapons

Story Behind Our First Manned Saturn V Shoot
By WERNHER VON BRAUN

- New Tube for Color TV Gives Brighter, Sharper Pictures
- How to Diagnose Troubles in Your Automatic Transmission
- How to Load Your Own Ammo

# The 62 caliber shocker.

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Our editors meet this need by keeping him abreast of everything that's new, or better, or different. They provide him with a wealth of consumer information and product evaluation to help him make more intelligent buying decisions. And he responds by coming back to Popular Science issue after issue.

Isn't this the kind of progress-conscious, product-conscious prospect you want to talk to? If you've got something new or interesting to tell him, he's eager to listen.

Cordially,

Charles S. Thorn

Charles S. Thorn
Executive Vice President
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November, 1968

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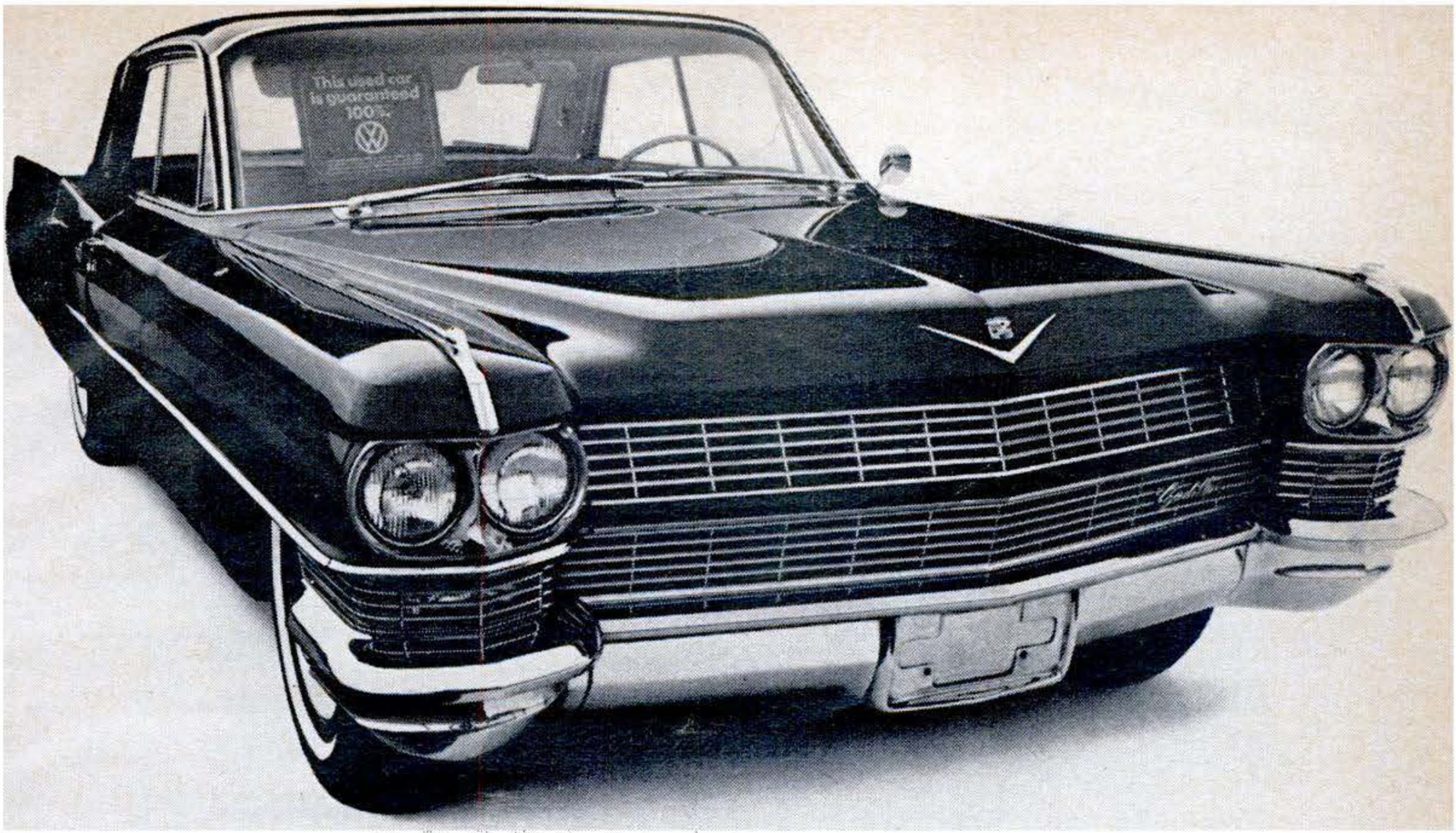


# A Volkswagen dealer will stake his reputation on it.

No, that's not a new model Volkswagen.

That's an old model Something Else.

And it's on a Volkswagen lot for the same reason any other car would be on a Volkswagen lot.

It's for sale. Along with most of the cars people trade in on new Volkswagens.

So why buy a used Something Else from a VW dealer, instead of from Somebody Else?

Buy it from a VW dealer, and you get his 100% guarantee for the repair or replacement of every major working part for 30 days or 1000 miles. Whichever comes first.

Engine. Transmission. Rear axle. Front axle assemblies. Brake system. Electrical system. Those are the parts covered.

They may make boring reading. But there's nothing boring about laying out a lot of dough to fix one of them.

That's why it's so nice to know that a VW dealer will take care of anything like that on any car he guarantees.

And that's why he's pretty particular about any car he guarantees.

When he finally gives it the guarantee, it means he's checked out the car completely. And fixed what needed fixing to begin with.

After all, a VW dealer has a reputation to think about. He can't have it known around town that you drove off his lot with a lemon. Even if it wasn't a Volkswagen.

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NOVEMBER 1968 Founded in 1872/Vol. 193 No. 5

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**Now This Is Really Flying!** PAGE 63
Settle back in the wicker seat of this strange craft for a joy ride into the blue. Its looks are antique, but performance and fun are 1968.

**New TV Color Tube Gives Brighter, Sharper Pictures** PAGE 68
Three electron beams from a single gun? Right. And PS shows you how it's done.

**Troubles of an Automatic Transmission** PAGE 78
The most common faults don't need costly repairs—just simple adjustments.

**AUTEC: Our Secret Undersea Test Range** PAGE 94
Come with PS to the Navy's "Cape Kennedy" of submarine warfare—where the latest anti-sub missiles play deep-water tag with fleeing subs.

**First Manned Saturn Shoot BY WERNHER VON BRAUN** PAGE 98
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COVER PHOTO BY OZZIE SWEET

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## COMING NEXT MONTH

**A quick preview** of outstanding features you'll find in December PS:

- Can We Ever Really Ban the Bomb? Noted writer Fletcher Knebel makes a unique proposal to eliminate the world-wide fear of nuclear destruction
- Tektite I—the fascinating story of how four scientists will live for 60 days in a "home" on the ocean floor
- How You Can Be an Expert Winter Driver—expert counsel on the special problems of driving in snow and ice
- How to Get Started in Home Movies
- The ABCs of Snowmobiling
- Smokey Yunick, "America's most famous mechanic," vs. a car-clinic computer
- 40 pages of home-and-shop features: projects for Christmas, new tools, techniques and materials, time- and money-saving tips.

**PLUS: 16-Page Special on Color TV.** A valuable handbook for the color-TV buyer—and the man who already owns one.

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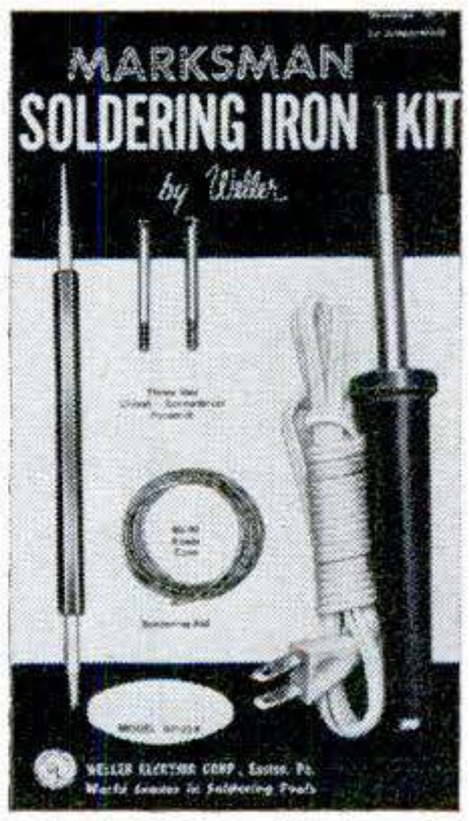


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# Advance Peek! 1969 Johnson Look-In

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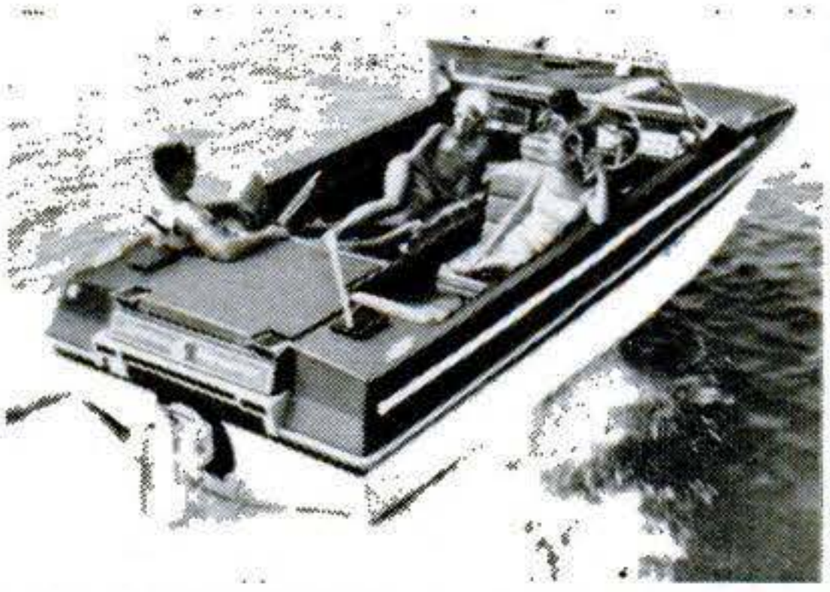

**SEA-FOIL REVELER.** New refinements improve performance of this 16-footer and its running mate, the open-deck Seasport. Choice of two open-deck 19-footers, too.

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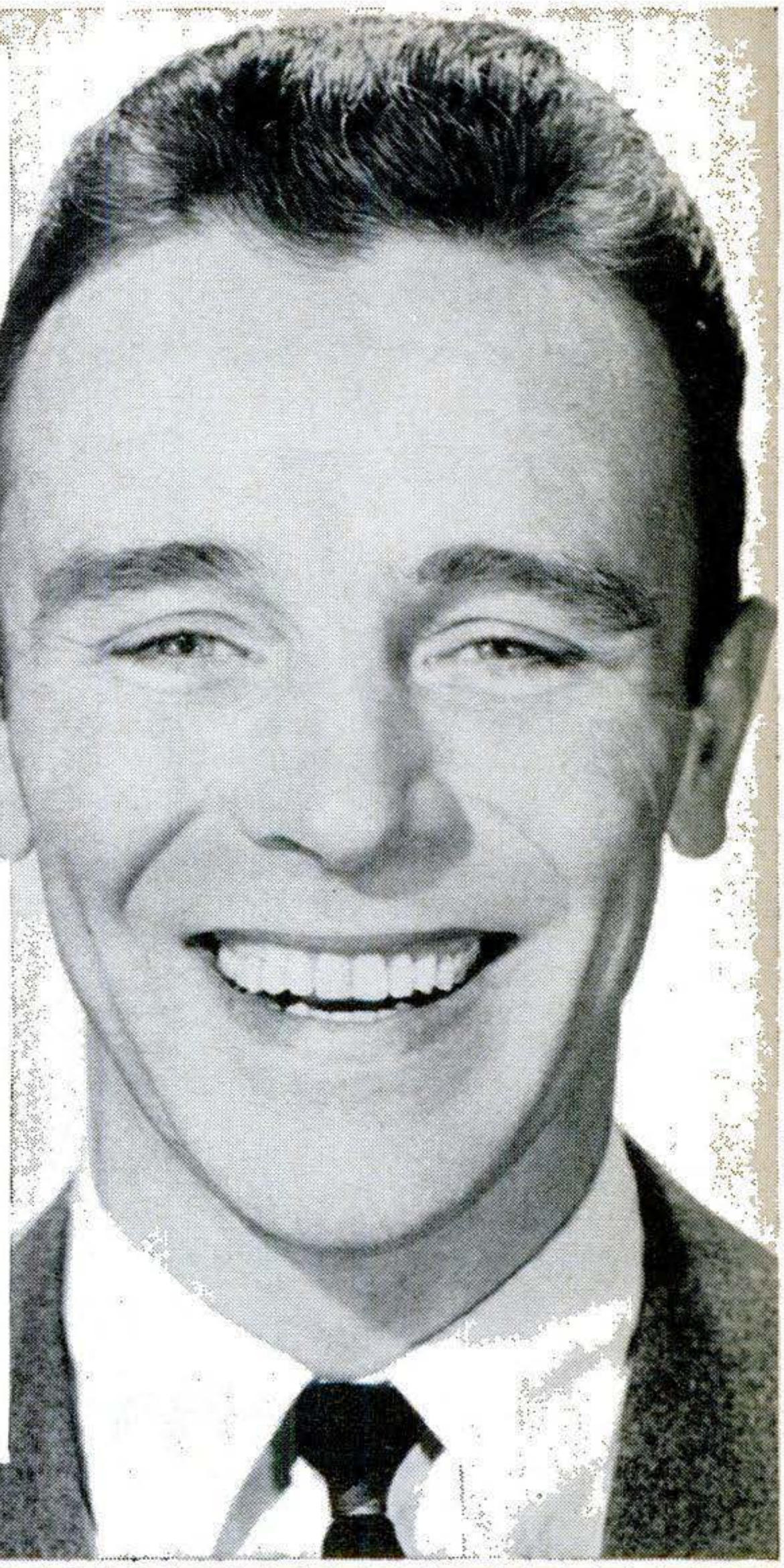

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# PS Readers Talk Back

### To the North Pole on snowmobiles

We certainly enjoyed "How I Reached the North Pole on a Snowmobile" by Ralph Plaisted [Sept.]. My interest was drawn to the description of cold starting where Walt Pederson used a torch made of gasoline-soaked rag to heat the gas and air at the carburetor. I hope that less-professional snowmobilers will not misunderstand the description of this aid to cold starting. Flame applied directly to the carburetor will destroy the plastic fuel-inlet turret and damage the diaphragms in the carburetor. When the turret is destroyed by flame, the fuel in the carburetor will ignite, causing a serious fire. It carefully stated in the article that the flame procedure was used at "minus-65-degree Arctic temperature," and I believe that this will not be required in the relatively mild minus-20-degree weather that is normal to lower Canada and the northern U. S.

D. L. DONOVAN, Asst. Chief Engineer
Tillotson Mfg. Co., Toledo, Ohio.

### Likes PS projects for fun and challenge

I have recently started reading PS and enjoy it very much. I have often bought kits from hobby shops, but they usually

turn out to be a complete fizzle. But I have found that many of the projects in PS are easy enough to build and hard enough to be fun.

STEVE PATTERSON, Lubbock, Tex.

### Interpreting auto-insurance ratings

"The Truth About Auto Insurance" [Aug.] is one of the most comprehensive stories yet produced for the layman. I think you have done a great job of setting up the problems plaguing the motorist and his insurance company. However, I would like to correct an error which crept into the article. You say "Allstate's safe-driver plan has eight categories. It has eight merit (discount) ratings and five surcharge ratings —the highest runs to 250 percent above the base rate." Actually Allstate's highest rate runs to 150 percent above the base rate. This is a common error many people make in analyzing our table. The top rate is 250 percent of the base rate, which translates into 150 percent above the base rate.

RAY EWING, Public Affairs Div.,
Allstate, Northbrook, Ill.

### PS has something for everyone

Your magazine has always been enjoyed by our family, even my wife enjoys some articles. It has continued to amaze us with the variety and scope of the articles published. Keep it up. You'll always have this subscriber.

CHARLES BINGHAM, Flagstaff, Ariz.

### Says gas brands really do differ

In September's "Readers Talk Back," John Runfola says the major brands and independents pull gas out of the same terminal. He should be advised that the various brands have different additives in their gas. Actually, as far as gas is concerned, it is basically the same, except for the additives and the octane rating. Then there is a difference which is great.

KENNETH R. LOTT, Clay Center, Kans.

### Steamed up over steam-car stalling

You ask "Is There a Steam Car in Your Future?" [Sept.]. My answer is an unqualified no as long as Detroit can stall the project. They have been doing just that for over 40 years. They will be "developing, researching, and experimenting" for 40 years more and telling a lethargic public that steam is an outmoded source of power.

E. EARL WILSON, San Lorenzo, Calif.

. . . The hodgepodge of engines shown in your September issue leads me to state that there will never be a steam car in anybody's future, at the rate present-day engineers are going.

For example: The four-cylinder single-acting engine those boys have been trying to peddle for 20 years is twice as heavy as the Stanley Twin Double-Acting. Their four-throw crankshaft is a bear to make and it takes a plumber's nightmare to reverse it. Another fell for Professor Doble's nightmare uniflow where the piston had to

*Continued*



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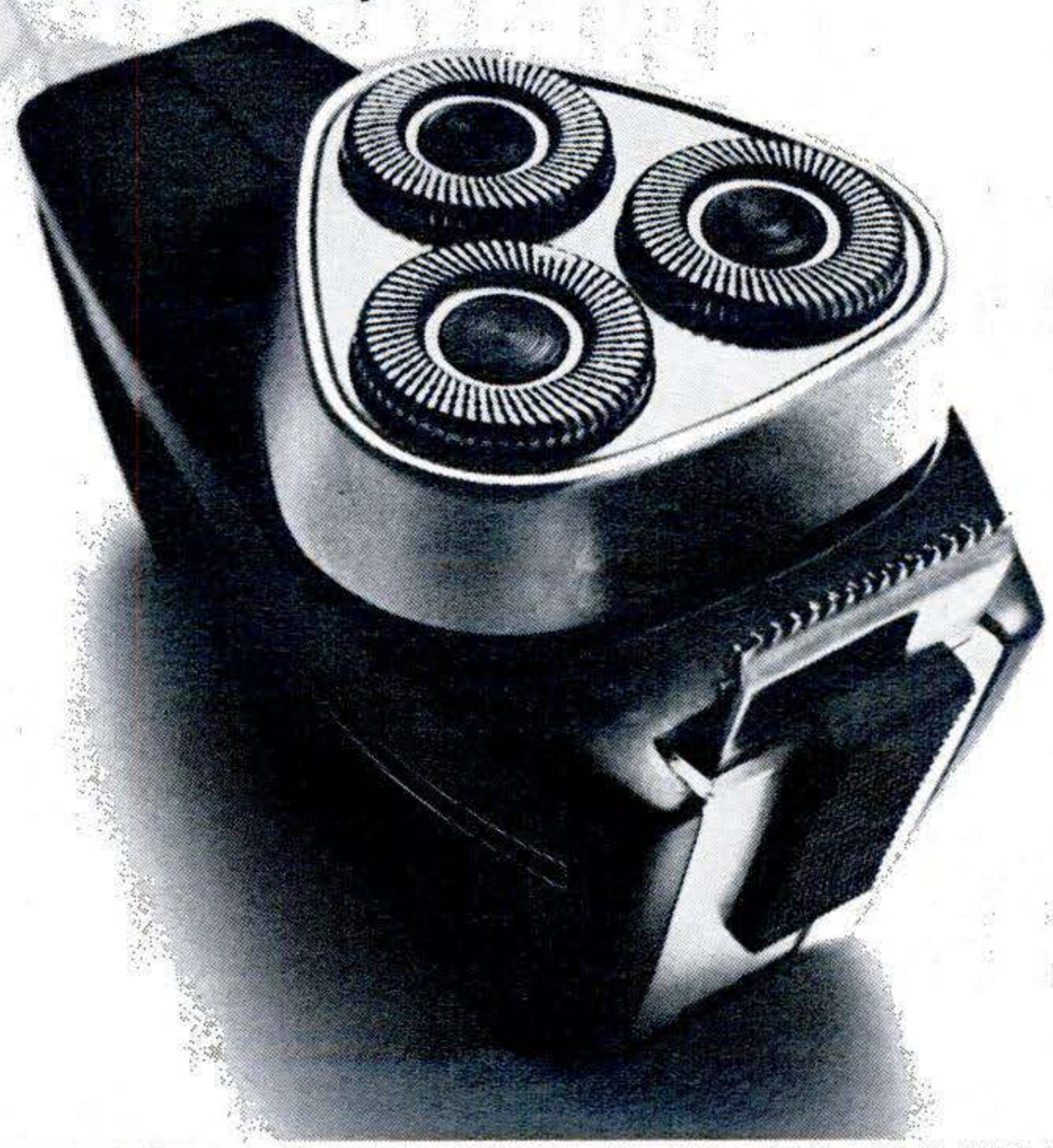

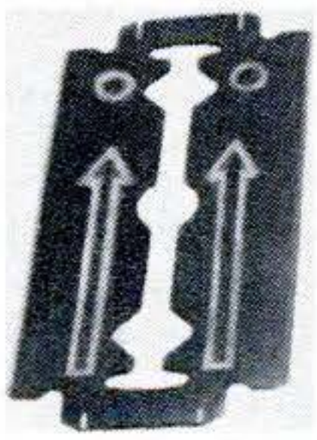

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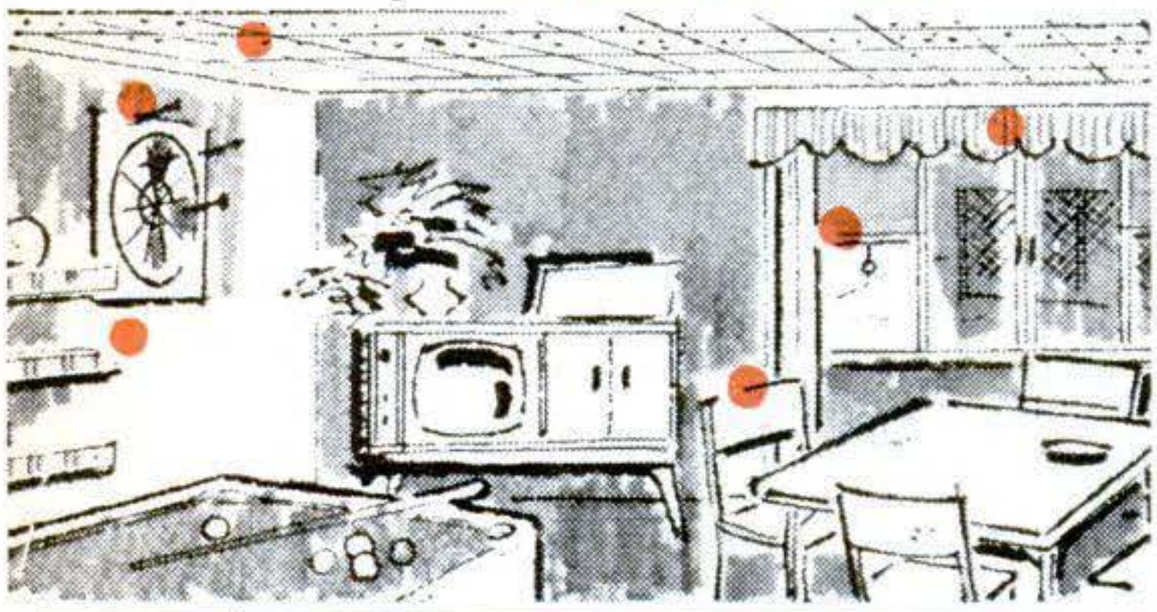

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## PS Readers Talk Back

[*Continued*]

be as long as the stroke and the cylinder had to be twice as long as the conventional single-acting engine.

So let's get down to brass tacks: There's only one practical engine for steam cars. That's the Stanley. The twin double-acting steam engine is instant starting, instantly reversible, and no engine can match it for light weight and power. The Stanley engine had what it takes in spite of its faults. It can develop 8,400 pounds of twist on the shaft and a total of 250 hp. in an engine weighing only 75 pounds!

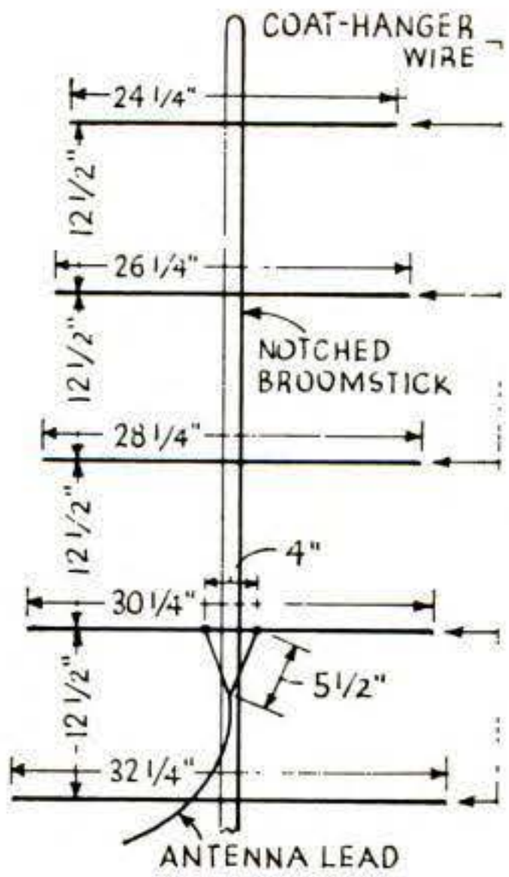
R. A. HILL, Detroit.

### About your TV antenna

"Your TV Antenna May Be Out-of-Date!" [Sept.] ignores the existence of shielded twin-lead antennas. I have found that the twin-lead antenna performs as well as co-ax, while eliminating matching transformers and special connectors. It does not need any stand-off insulators and can be run just about anywhere conveniently. One problem is that it's thick and heavy, and needs some kind of extra support at both ends, or it will break the wires.

A. A. BOON HARTSINCK, Burbank, Calif.

. . . Your article reminded me of an antenna I built a few years ago when the Superbowl was blacked out in Los Angeles, causing anger among the residents around here. A local radio station distributed plans for this antenna, which it said could pick up the broadcast from San Diego (over 100 miles away). Because of the mountains surrounding my house, reception was not possible. But friends of mine living on flat terrain were able to receive the program. The color reception on local channels was superb and equalled that of our expensive factory-built antenna.




PAUL DI BIASE, Woodland Hills, Calif.

### Jiger is reborn

In "Swinging Go-Anywhere Cars Scorn Highways" [Aug.], PS reported that the Jiger had suffered an unfortunate demise. The little vehicle has since been reborn under new ownership—Breton Versatrek Ltd. About 5,000 Jigers will be produced

*Continued*



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Lazy Pipe Tobacco

If you think pipes were never meant to be hurried, you've come to the right tobacco: Bond Street.

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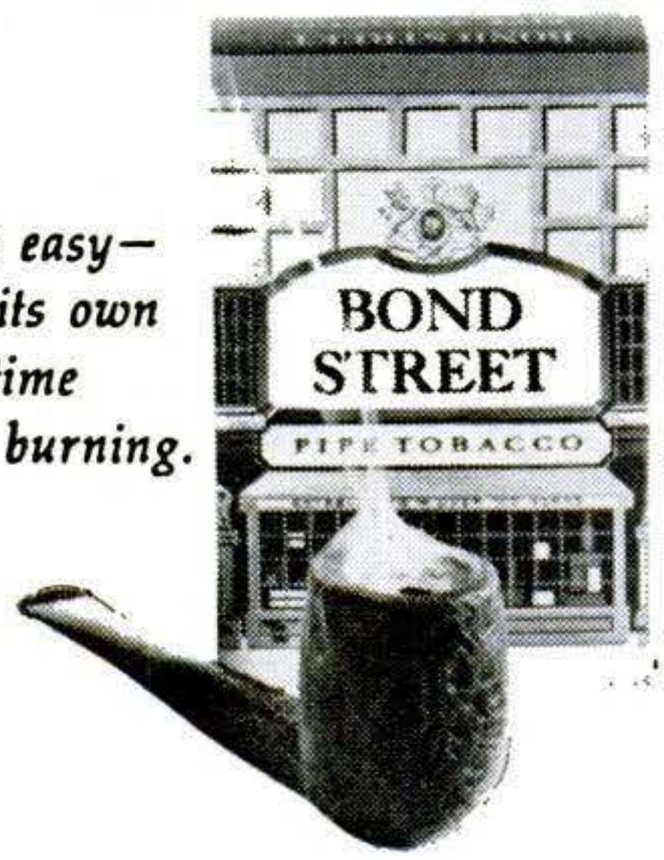
*Lights easy—takes its own good time about burning.*




## PS Readers Talk Back
[*Continued*]

within the next eight months. So the Jiger is far from dead. It's still an infant, ready for rapid ripening.

WILLIAM MACDOUGALL, Don Mills, Ont.

### More uses for golf carts

September's "Picture News" showed a golf cart that had been turned into a shop-

ping cart. About a year ago, my husband built this electric trike out of a golf cart.

MRS. R. A. MITTELSTADT SR.
Burnsville, Minn.

### Raising the roof about names

In "Short Cuts and Tips" [Sept.] you show how to put up a decorative roof on a mailbox. It's referred to as a mansard roof, but actually it's a gambrel, or barn, roof. A mansard roof has eight pitches, whereas a gambrel roof normally has four and sometimes six—as in your drawing.

CHARLES NEWBY, Kokomo, Ind.

### Misplacing the icebox

Someone goofed in "World's Biggest Icebox—in Florida" by putting it and Eglin AFB in Panama City. It's in Valparaiso, Fla., some 50 miles west of Panama City.

JOHN C. BARRY, Ft. Walton Beach, Fla.

### PS Plays Santa Claus

The little pig-shaped cutting board in "What You Can Make with Counter-Top Cutouts" [Nov. '67] intrigued me last year. This year I got around to making Porkie—and a mouse with a leather tail and ears! They're great Christmas gifts.

J. K. L. WEST, Passaic, N. J.

Want to get something off your chest?
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# "Say, Smokey—"

## A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address.

*"What can you tell me about torque wrenches? There's much difference of opinion about thread cleaning, lubrication, and the general technique of reading them accurately."*

E. WOLDSETH, Tacoma, Wash.

To get a good reading, everything must be clean, and free, and have some lubrication. But in automotive lingo, the engineers specify "nominal figures." That means figures that will include certain problems that are inherent in the repair of vehicles at a realistic cost. The Sturtevant Company in Addison, Ill., makes a very good torque wrench and puts out a booklet that is a good guide to its use.

*"My 1968 Ford Country Sedan with 390 and Cruise-O-Matic has Goodyear radial tires. Since new, it has had a rough vibration at 65-75 m.p.h., though not at 35. The Ford service manager claims it is caused by the tires having a runout of up to 5/64". The Goodyear manager claims the fault is in the car's drive line. I have had the tires balanced on both a bubble machine and a dynamic balancer, with no improvement. Looks like I'm caught in the middle. Will you help?"*

WILLIAM R. BRANDT, Stillwater, Okla.

Go to some shop with a Kem True Tire machine, and get those tires round. Then rebalance. Some money and tread will be gone, but so will your vibration. You can balance even a square block for free spin, but how do you think it would roll down the road?

*"When I take my 1960 Pontiac Catalina 389 with four-speed Hydra-Matic to the drag strip, it has a horrible bog-down period at about 60 in third gear. Between 60 and 70 it comes on like a 427, then goes into fourth. But the lag period cuts at least a second off my time. A new electrical system helped some. What's up?"*

PAUL PRATT, Lexington, Ky.

You have a hole in the torque curve there, for the gear the engine is pulling. The two most effective changes in torque characteristics would come about through changes in camshaft and carburetor.

*"I have front-seat shoulder belts in my '68 Dart 270. These are fixed to the roof and when not in use are pretty well hidden. But I thought their main purpose was use. Trouble is they just cut my throat—and the passenger's as well. Is the purpose of these belts to answer a law, or help people in case of a crash? Can't I ask the dealer to reinstall them like in Volvo on the doorpost for free? Or if not for free, what would be the cost? My second problem is why are these cars so small inside when they are so large outside? I am six feet tall, and my knees are still bent when driving."*

A. J. SORIGNET, Montreal, Que.

Shoulder belts are still not fully worked out, and at this time are still pretty much of a joke in most cars. To be fully effective, they would have to be fastened in a secure place below and behind the user. I don't believe it's the dealer's responsibility, since he has to take them as is from the factory. Cars are so small inside because styling sells cars, and a tall roof makes for poor styling. Move your seat rails back to get as comfortable as possible.

*"I am interested in getting a four-wheel-drive vehicle for rough off-the-road use.*

*Continued*



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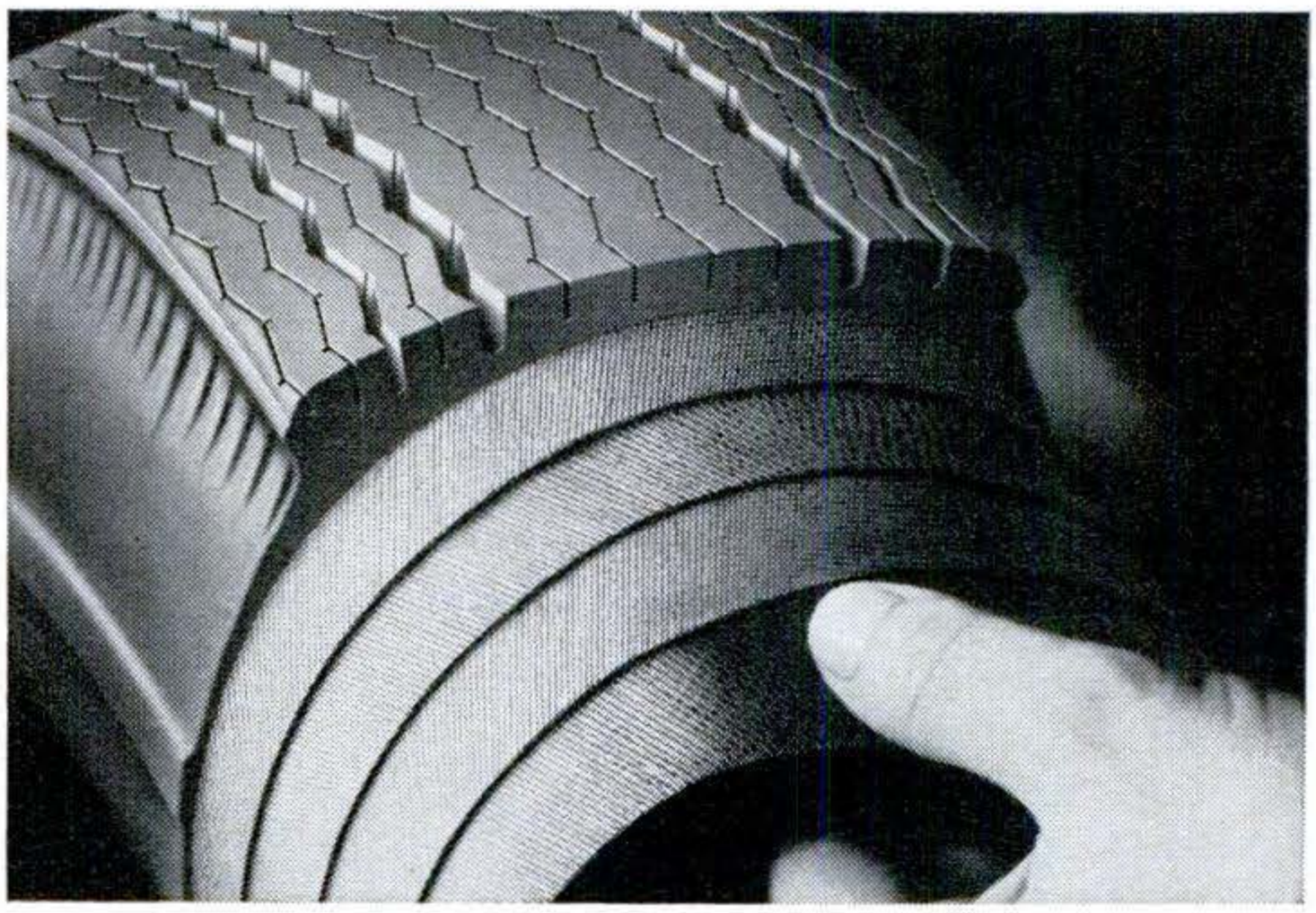
# The Round Tire is Ply-ier



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"Ply-ier?" That's right. We mean Atlas Plycron* —The Round Tire—has the strength of four full plies as part of its rugged overall construction. That's just one of the reasons why this quality tire can roll at least 3,000 miles further than tires that come on most new cars. Once again, grueling road tests against complete sets of tires for new 1968 cars proved it.

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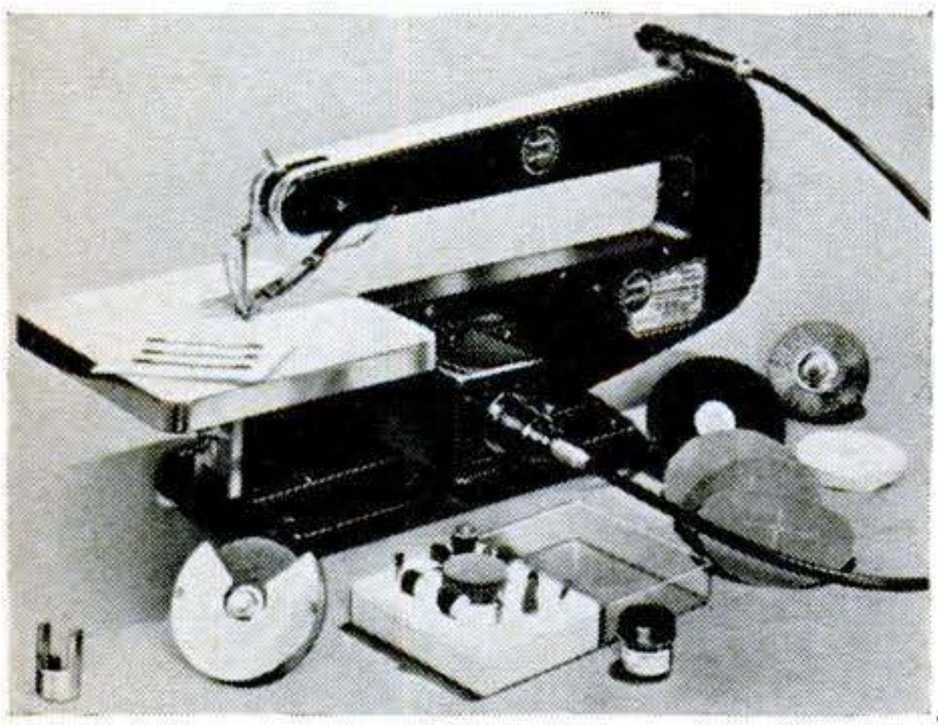
# This 5-in-1 power shop is a jig saw, disc sander, buffing wheel, bench grinder and flexible shaft unit



**Dremel Moto-Shop** begins with a big-capacity, 15"-throat jig saw that handles intricate scroll work to full-size furniture. Unique power take-off makes it a shopful of power tools in one low-cost, compact unit. Slip-on attachments convert it into a disc sander, bench grinder, buffing wheel or flexible shaft unit. In seconds! Lets you sand, grind, polish, sharpen, rout, drill, carve with speed and precision. It has a powerful, ball-bearing rotary motor and rugged construction. Cuts up to 1¾" wood, light metal, plastic, etc. Yet, it's so portable (weighs only 10 lbs.) you can take it to the job, store it on a closet shelf. *Model 571* with sander attachment, $39.95. *Model 572* completely equipped with attachments, $49.95.

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## "Say, Smokey—"

[*Continued*]

*Which would be the best engine for this—a big six-cylinder, or a V-8? Some say the big six would be best. Why? Are limited-slip differentials worth the extra cost in a four-wheeler?"*

GARY DAVIS, Turlock, Calif.

I believe a small V-8 would be the best answer for power. You could try an International Scout, since they are pretty well built. Limited-slip could be an asset, but you would have to keep a sharp eye on the thing for correct greasing.

*"My 1965 Plymouth Fury has been an excellent all-around car to drive, with one very annoying exception: stalling in damp weather. It stalls the minute my foot comes off the accelerator. This stops as the engine warms up. I've been told by several mechanics that this is a basic fault in the car, and that I'll have to live with it."*

DR. IRVING S. PRICE, Glen Ridge, N. J.

The mechanics are not telling you the truth. It *has* been a big problem, but there's a fix. Contact your local Chrysler service representative. He can supply the latest information to the local dealer and have him clear up the stall problem.

*"My '63 Ford wagon with 356-cu.-in. V-8 is a very heavy oil consumer at 54,000 miles. This didn't occur on my other two Fords, which I also always drove at posted speeds. I have always used good grade X100/20 oil, changing it and the filters regularly. What's the answer?"*

P. A. GRANT, Richmond, B. C.

Rings and valve guides are often at fault in this problem. I think you'll find that your rings are stuck in ring grooves and your valve stems are leaking oil. I also guess your engine has a plugged or partially plugged crankcase vent.

*"We have a 1966 Chevrolet Carryall with the 292-inch six and three-speed overdrive transmission. It has leaked oil around the flywheel housing since new. The dealer has replaced the rear seal four times and the oil pan once; put in a rear main bearing, new frost plugs, and a new camshaft plug. Supposedly, he has also checked the crankshaft for out-of-round. It still leaks a few days after the seal is replaced. What do I do now?"*

LON F. ALEXANDER JR., Los Alamos, N. M.

Get somebody to pull the transmission and clutch assembly, then clean up behind in the leak area. With the engine running,

*Continued*



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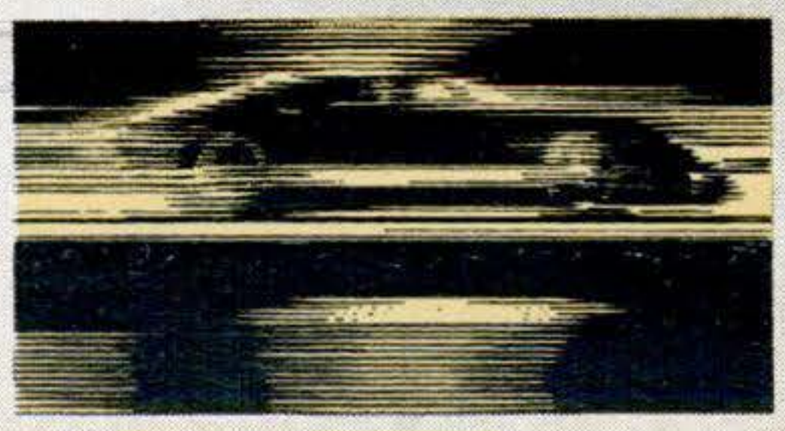
**Autolite** Ford



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## "Say, Smokey—"

[*Continued*]

you can then accurately spot the leak.

*"There's a non-rhythmic clunk in my '68 Plymouth Fury III. It sounds something like a loose shock absorber in the rear, and occurs while backing up, and at forward speeds up to 30 m.p.h. The service people at the dealership say it is an accumulation of tolerances in the drive shaft, and nothing can be done to eliminate it. What do you say about it?"*

H. V. PLOUGH, Dallas, Tex.

Sounds from here like "torque lock." That happens when the drive shaft, under torque, does not slide freely. I don't think anything can be done about it, except to wait and see if it will loosen up as you get more miles on it.

*"I can't center the steering perfectly in my '66 Pontiac Ventura with power steering. I have new tires, and I've always had my wheels balanced and alignment checked. If I hold my steering wheel straight, the car wanders to either left or right. The dealer and a number of alignment shops have tried to adjust this some way, including putting a drag on the steering wheel, but to no avail."*

JOSEPH GESUELE, Cliffside Park, N. J.

I don't think this problem is caused by your steering gear. Go to a rear fender and shove the car from left to right hard, and see what happens. You probably want tires that are stiffer laterally, and a general stiffening up of the chassis.

*"At 3,000 miles my Dodge Coronet 500 developed a little knock, which the service manager said was a fuel-pump knock, and not to worry. At 6,000 miles I asked him if a new fuel pump would stop the knock and he said no. So what's next—the knock is still with me."*

STANLEY GOLUBSKI, Fredonia, N.Y.

Your service manager is probably right, but to check it, try this: Have somebody take the pump off, then gravity-feed the carburetor and start the engine. You'll soon know. All I can say is, if you can't live with that knock, you can shop around and find several other makes of car that do not have it!

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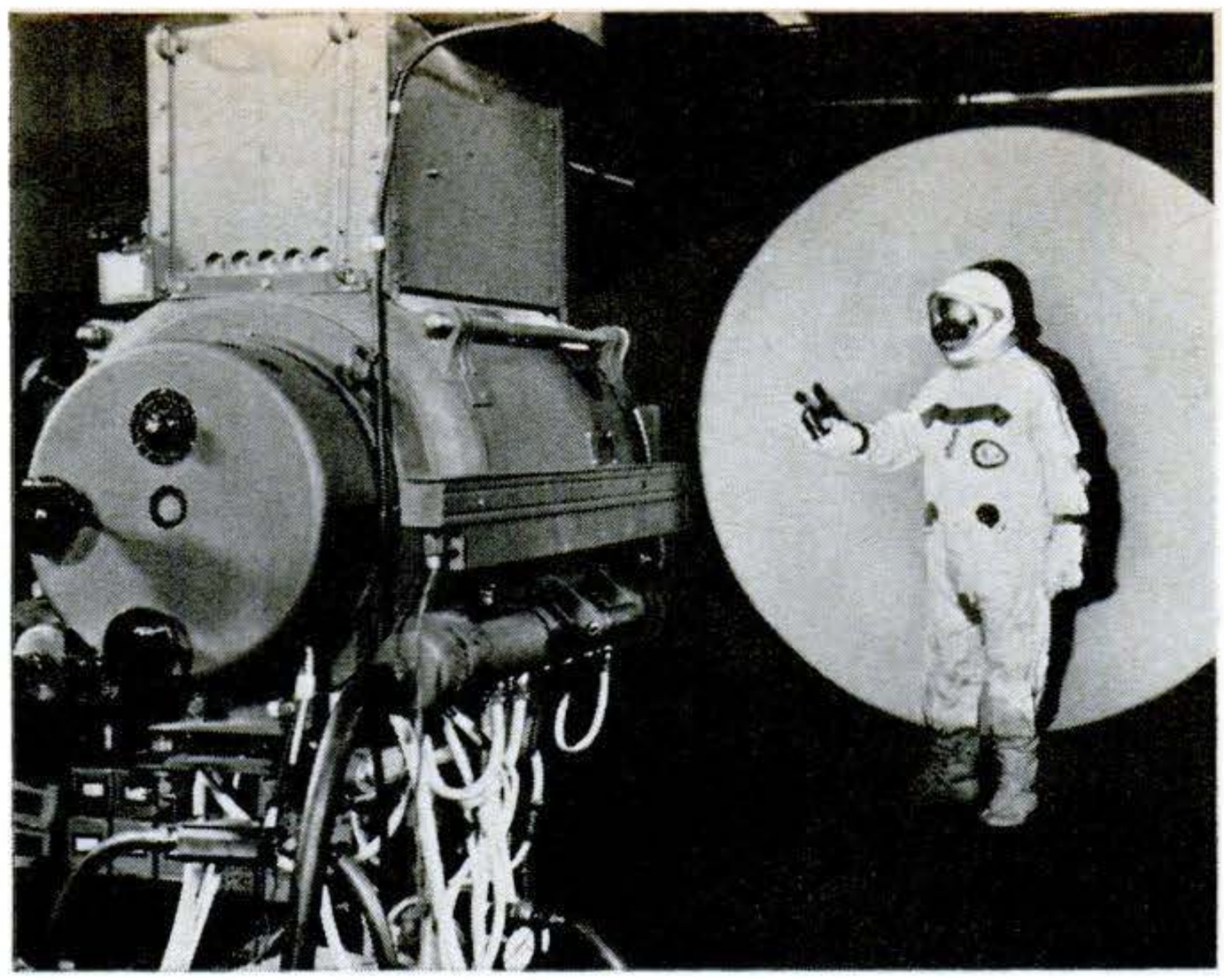
# Science Newsfront

## Last-minute news and notes to keep you up-to-date

By W. STEVENSON BACON



**Sunlight around the clock** would be possible with this new solar simulator four times more powerful than any to date. The 120-kw. carbon-arc light duplicates the spectrum of sunlight in space, burning at 10,000 degrees F. (about the temperature of the sun's surface). In astronaut's garb and dense goggles, a technician checks output of the simulator, to be used for testing space materials. Four of the lights, developed by Union Carbide and Genarco, Inc., could light a football field.

---

**Smokeless jet aircraft engines** may help clear the skies of air pollution. Unlike car engines, the jets give off only a small amount of carbon monoxide and other toxic gases; but unburned carbon particles leave a trail of smoke. The answer? Combustion chambers (burner cans) added to the engines to incinerate carbon particles and a less-rich fuel mixture. In a research effort, Pratt & Whitney Aircraft is making burner cans; nine of them are added to each jet engine. The first smokeless jet plane, a Boeing 727 of Pacific Southwest, is already flying.

**Electronic skid control for your car** is the latest from Sweden. The simple system uses magnets attached to one free-rolling wheel and one drive wheel. Induction coils on the car body pick up magnetic impulses as the wheels turn. By comparing the frequency of the impulses from the free-rolling wheel with those from the driven wheel, it is easy to detect a difference—due to skidding. Inventor-engineer Helge Ceder further refines the system so it lights a signal and, at the same time, cuts down on the gas when skidding goes over a preset limit. The limit is variable, depending on speed, acceleration, and degree of ascent. The device also can be used as a speedometer and a speed-limit indicator.

**A revolutionary idea in air conditioning,** a ceiling perforated with hundreds of quarter-inch holes through which cool air flows, is being designed and tested with the help of a computer. Purpose of the research, being conducted by Drs. Paul L. Miller and Ralph G. Nevins of Kansas State University, is to develop a system that will keep a room evenly cool and comfortable without drafts. They've air-conditioned the ceiling of a nine-by-12-by-20-foot room. Special anemometers and thermometers measure air speed and temperature in 216 locations with different air volumes and cooling capacities. With four years of research behind them, the scientists will compare their findings with ordinary systems—all to keep you happy next summer.

**A unique new engine without a crankshaft** has attracted the interest of a major automobile manufacturer. It has no connecting rods either—just hydraulic fluid below each of its pistons. On firing, the fluid in each cylinder is forced through a turbine connected to the drive shaft. It then flows to an opposed cylinder, driving its piston upward. Valves and clutches take care of the opposing flows of fluid, keeping the turbine turning in the same direction. Designed by André Brulfert and André Hoss of Avignon, France, the engine has been run at 16,000 r.p.m. It is said to use one-fourth less fuel than conventional engines for the same output. According to reports, Chrysler Corp. is investigating.

**Leakage current is one thing,** but how much

*Continued*



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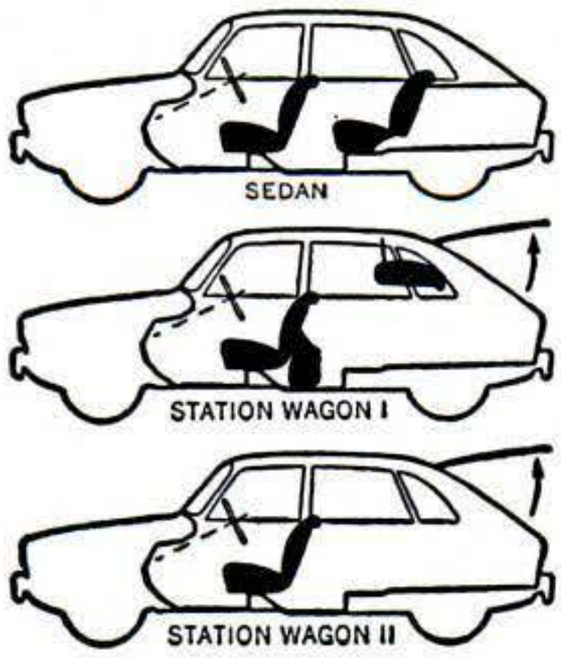
# CHAPTER TWO: THE RENAULT 16 SEDAN-WAGON

Our story opened with the Renault 10. And that chapter is being written every day. At last count, there were over 35,000 Renault 10's on the road.

And so the stage is nicely set for our latest installment: The Renault 16 Sedan-Wagon.

The Sedan-Wagon. Besides being a new chapter for us, the Sedan-Wagon represents a new chapter in the industry.

Until now, even if you only needed a station wagon occasionally, you had to drive one around all the time. With the Renault 16, you drive around a sedan. And when you need a station wagon, it turns into a station wagon.




The front-wheel drive. Quite logical. The engine up front to get maximum hauling area in the rear. The drive wheels also up front to get maximum traction from the engine's weight.

The engine. Pressure cast aluminum block. 5 main bearings. And a sealed liquid cooling system that virtually eliminates the bother of having to add anti-freeze. It can milk 28 miles out of a gallon of gas, and still manages a top speed of 93 mph. It is so well put together that you could roll up 30,000 continuous miles at 85, as we did, back and forth and back and forth between Rome and Milan.

The seats. They're every bit as comfortable as those in the Renault 10. And the seats in the Renault 10 have been stacked up against the seats in the Rolls-Royce.

The road manners. The suspension is soft, without being mushy. Each wheel moves up and down independently, controlled by long torsion bars.

The price. The Sedan-Wagon sells for $2,445.* The price of most sedan-sedans.

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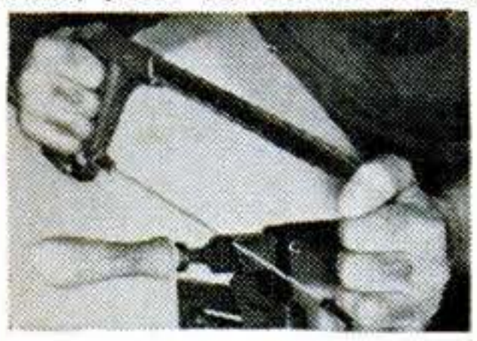

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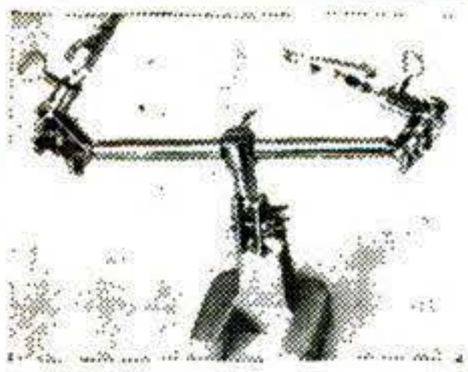

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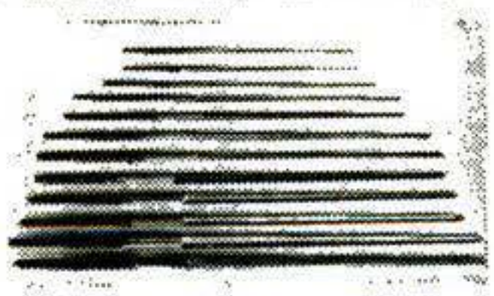
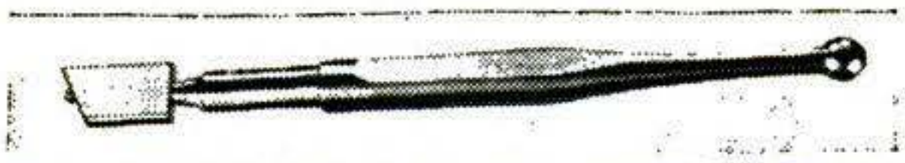
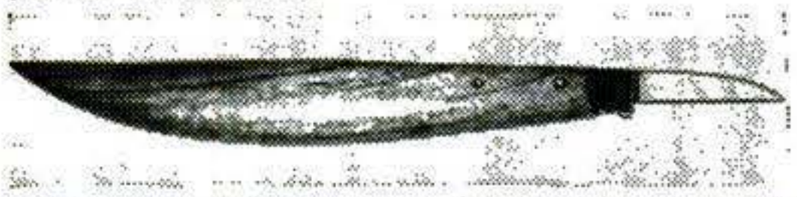


**D. MINIATURE REAMERS.** Like having drills of all between sizes. Just insert in hole and twist back & forth to enlarge as desired. About 2¾" to 6" long. Diameters about .012" to over 5/32". Taper .015" dia., or less, per inch. Select tool steel, precisely tempered to cut mild steel, other metals, plastics. Set of 12. **$5.00** ppd.

**E. JEWELERS' METAL SHEARS.** Extra-hard blades for accurate, fine cutting of steel, other metals, plastics, leather, wire, etc. Finest professional quality. 7" long. Specify straight or curved. **$3.50** ppd. Both, **$6.50** ppd.



**F. GENUINE DIAMOND GLASS CUTTER**—Now you can easily cut any glass or mirror up to ¼" thick. Requires little skill. Head swivels or locks rigid. Outlasts dozens of ordinary cutters. **$4.90** ppd. (2 for **$9.30**).



**G. FINE QUALITY KNIFE,** ideal for woodcarving, model work, pattern making, electronics, or as general bench knife. Manganese alloy steel blade hardened to 57-58 Rockwell C to take and hold a keen edge. Beautiful lacquered cherrywood handle. Rigid 1-⅞" blade. 5-¾" comfort-shaped handle. **$1.60** ppd.

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## Science Newsfront
*[Continued]*

does it take to startle you? This is what Underwriters' Laboratories hopes to learn in a new research program designed to make your home appliances safer. Leakage current is the small current found on metal surfaces of most electrical devices. The most frequently quoted limit, five milliamperes through 500 ohms, presents no shock hazard, but researchers point out that it can be felt. The result could be a secondary accident if a hot appliance were dropped.

**Many of the secrets** of nature—both biological and physical—have been unlocked using X-ray diffraction techniques. This tool, which depends on recording the diffraction pattern resulting when X rays are passed through a crystalline substance, has received a completely unexpected but welcome boost. Bell Labs new Picturephone camera tube, which has a semiconductor target [PS, June '68], has much better sensitivity and response to X rays than tubes designed for the purpose, costs much less. It's expected to find wide use in research and testing of electronic components and crystal orientation. The photo shows a "live" X-ray image of a crystal.

**Electrocardiograms of ambulance patients** can be flashed ahead to the hospital with new NASA-developed chest electrodes now undergoing test by a Los Angeles ambulance service. The electrodes, originally for pilots flying the XB-70 and wingless lifting bodies, are slim bare wires that can be instantly attached to a person with a quick-drying silver-glue combination. Their signals are sent by radio to the hospital where physicians study them as they are traced out on a visual recorder. The technique is expected to be of great value in cardiac cases.

**We-did-it-again department:** In the March issue PS readers were treated to a full-color preview of Dr. Jacques Piccard's new submarine, the PX-15 ["Deep-Diving 'Lab' for My 1,500-Mile Drift in the Gulf Stream Depths"]. An artist's drawing showed all the interior details—despite the fact they were not yet finalized. Attending the chris-

*Continued*



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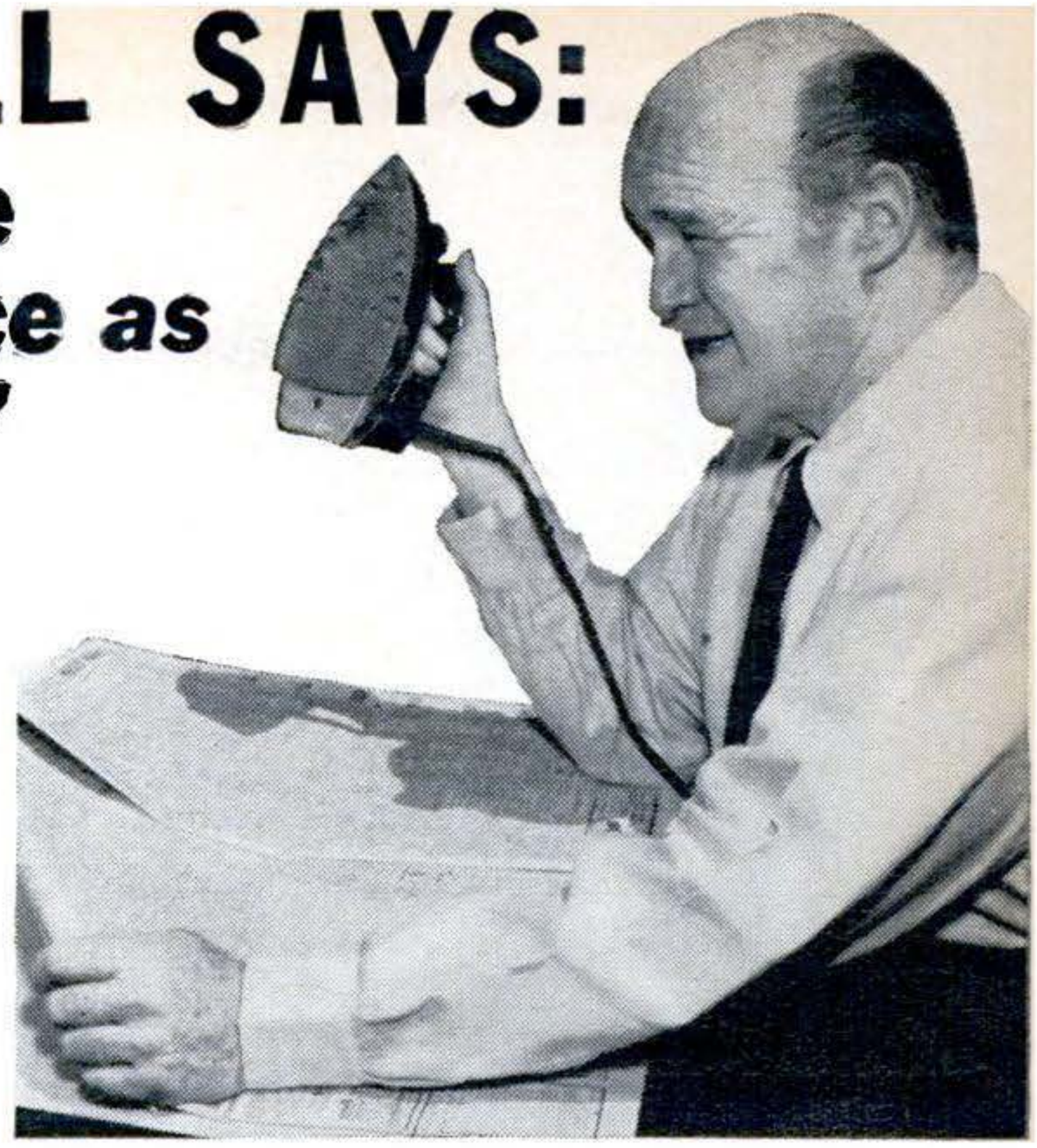
# TOM McCAHILL SAYS:

## "Good Appliance Repairmen are Scarce as Edsel Dealers!"



I don't think anything disturbs me as much as trying to find an appliance repairman . . . and finding out I'll have to wait my turn because he has more business than he can handle.

With over 400 million Appliances now in use, and more coming every year, there just are not enough repairmen around to take care of every Mrs. Jones who wants a broken Appliance mended in a hurry! And that's why a smart guy could really clean up in the Appliance repair field.

Some years back, almost anyone could do a fast repair on an iron or toaster with a bit of fancy tinkering. But today's complicated Appliances call for a special brand of know-how the average Joe doesn't have without training. Appliances are loaded with thermostat controls, solenoids, and special devices. Unless a repairman has a working knowledge of these parts, he won't even get to first base.

That's why I want you to take a good look at the home study course offered by the Appliance Division of the National Radio Institute. They show you all about repairing home and commercial Appliances—even farm Appliances and small gasoline engines. If you're interested, they also include a special package covering air-conditioning and refrigeration repairs. The cost is surprisingly low, and even includes a special Appliance Tester.

NRI is one of the biggest and best schools in the field, and has been around since 1914. They have a staff of 150 people in Washington, D.C., who are equipped to guide you through the easy course with expert and personal instruction.

Take it from Tom . . . this is one of the easiest and most rewarding fields a guy can enter today. You don't need a college education, you don't even need to know the first thing about Electrical Appliances when you begin your training.

There's nothing to lose . . . except the price of a stamp on your letter or postcard. Fill out the coupon below *now*, before you turn the page. Get the full rundown on the training that can increase your spare time income or provide you with a business of your own a lot sooner than you think. In just a few short months you could be ready to take the first profitable step towards a new and rewarding career. Do it!

Tom McCahill

TOM McCAHILL

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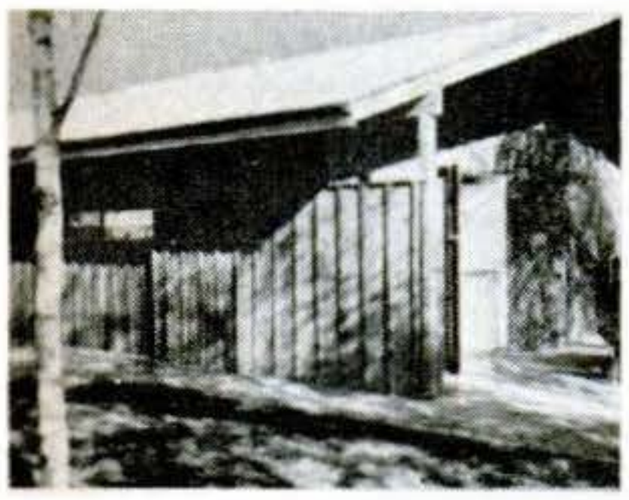

Save hundreds of dollars building your own garage, carport, patio. Easy-to-follow directions provided.

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Do you know the best way to remove the finish from fine old furniture so you preserve the aged color of the wood? Do you know how experts save half the cost of band saw blades? Have you thought how valuable it would be to learn how to fix drafty, leaky windows... how to correct common car engine problems without having to pay a garage mechanic anything he chooses to charge you?

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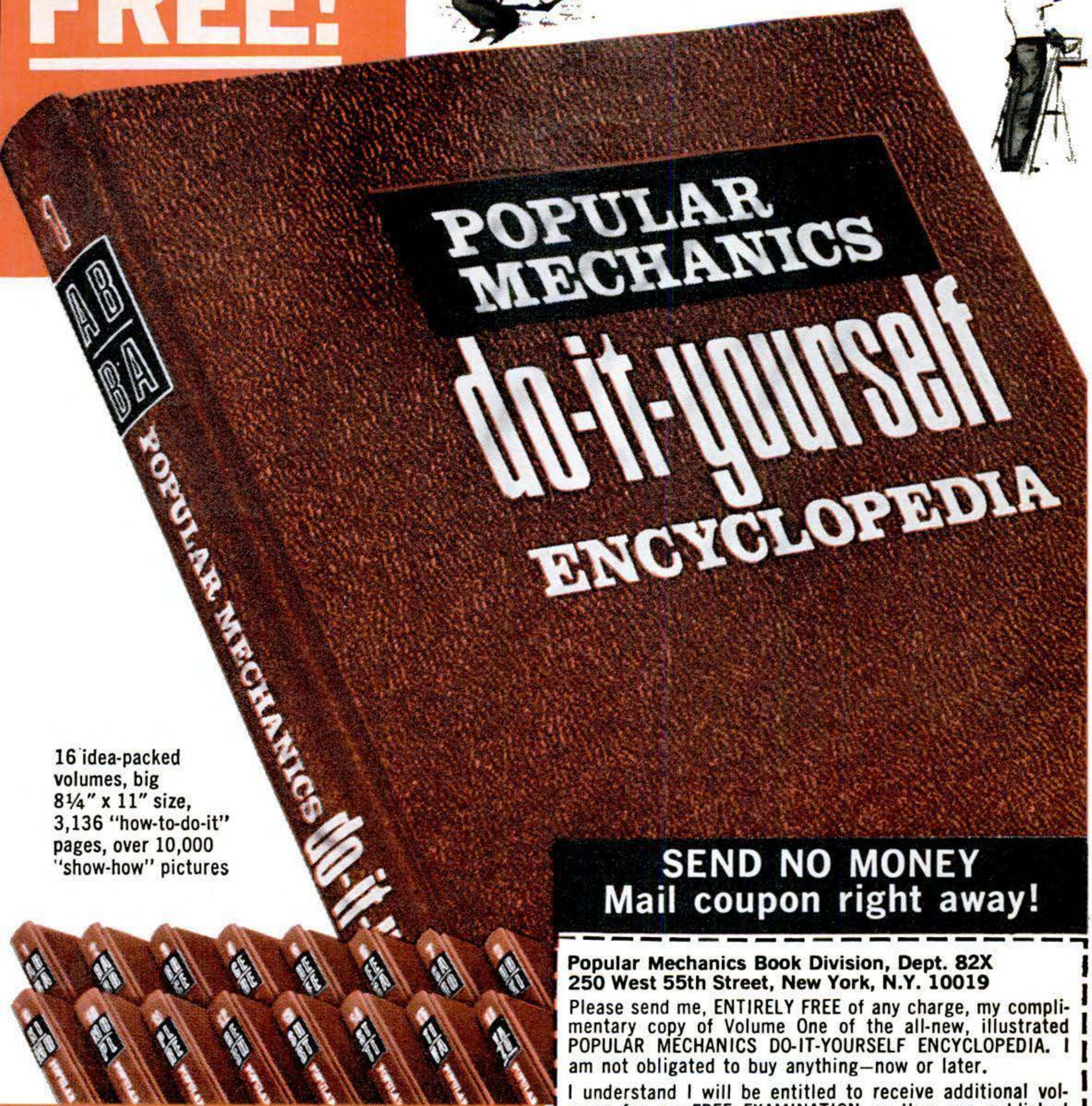


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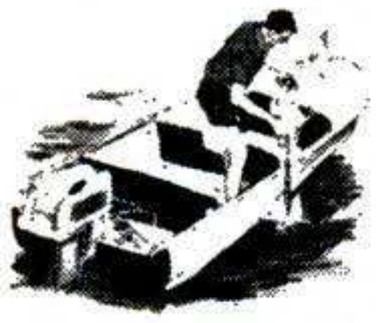

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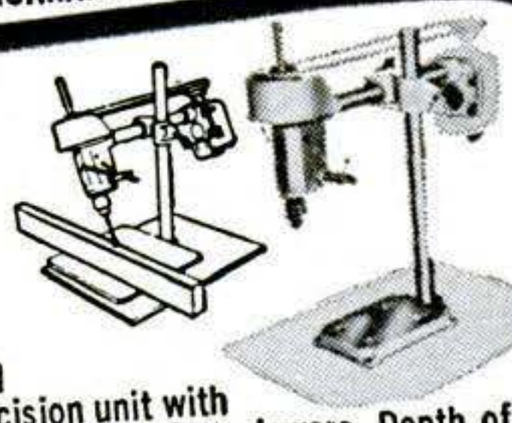

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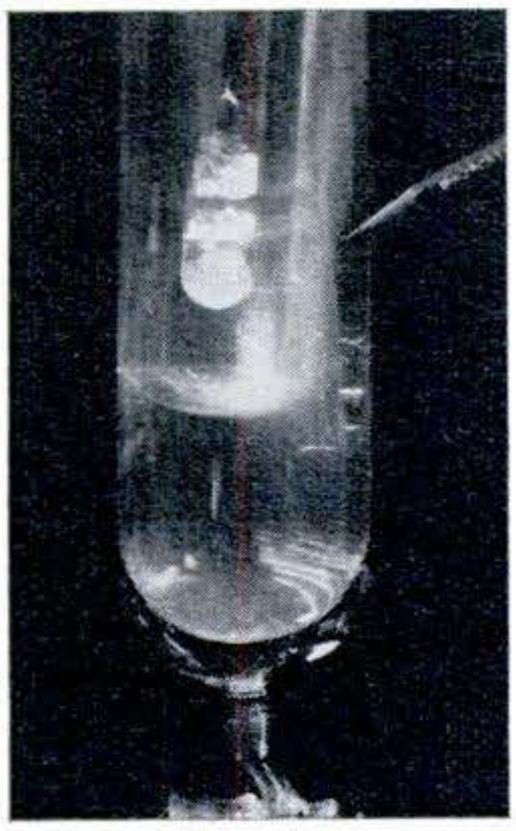
## Science Newsfront

[*Continued*]

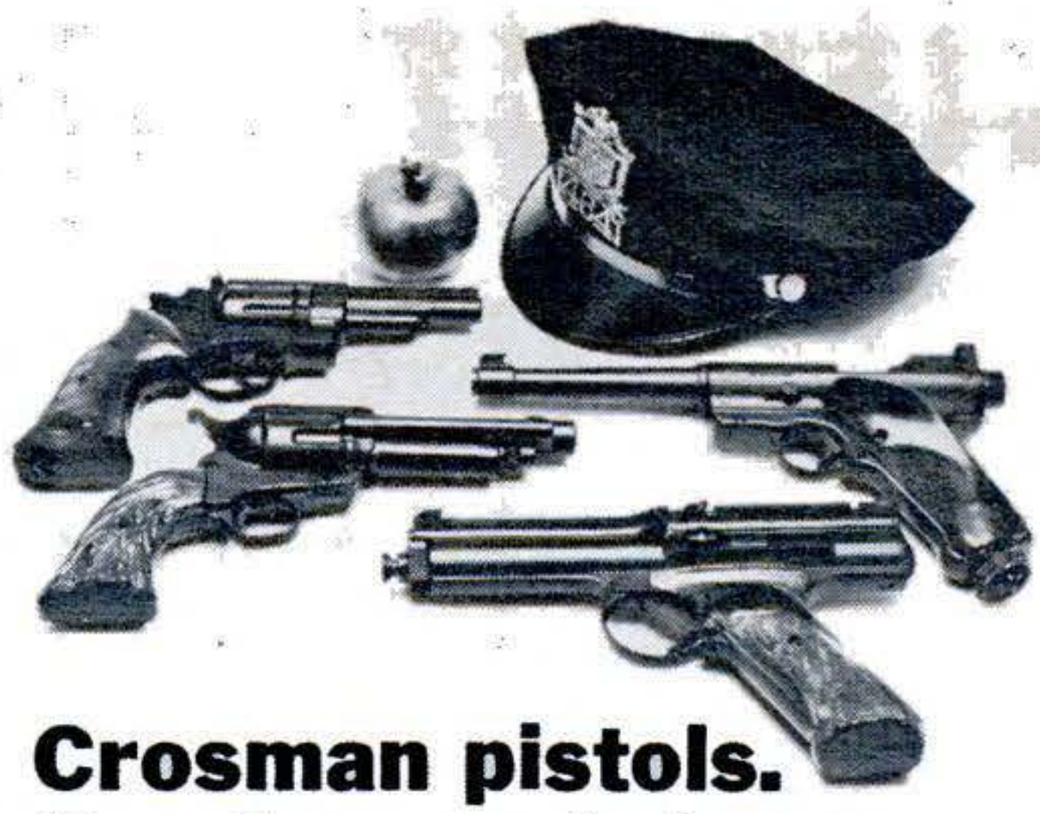
tening of the PX-15, now called the Benjamin Franklin, at West Palm Beach, Fla., Aug. 21, we can report we were accurate—right down to the last porthole. Says Dr. Piccard: "We'll test the sub at operating depths and prepare for the drift mission for the rest of the year." Look for it to happen early in 1969.



**Frozen oxygen cubes** for breathing could make life in outer space a lot easier: Just four two-inch cubes would give enough oxygen for 12 man-hours. Studying the problem for the Air Force is Aerojet-General Corp. Findings to date: Solid oxygen as an emergency or reserve source would last 10 times as long and take up less space. It would be less advantageous for a direct space-cabin supply being used continuously, since the equipment needed to convert solid oxygen for breathing nullifies its weight advantages. At right a magnet is used to lift solid crystals of oxygen.

**Transistors are knocking tubes** into history. Now there are transistors that are taking over the last refuge of vacuum tubes—high-power radio transmitters. In a new RCA development, two large silicon wafers, an emitter-base and collector-base, are formed separately, then laminated under heat and pressure into a single structure. Finally, the giant transistor is sealed in glass.

**A cannon roared at blindfolded students** on the Columbia University campus recently, but fortunately it had nothing to do with violent disorders. The shells were blanks and the motive was not mayhem but better understanding of human perception. According to John Molino and Prof. Eugene Galanter who conducted the experiments, what people hear depends partly on how they hear and on the acoustic environment. Noise pollution makes the problem even more critical. Volunteers were asked to identify directions of cannon shots (from a miniature cannon) and hisses, tones, and other sounds sent over loudspeakers. The researchers apologized for alarming neighbors, but pointed out that this time the sound and fury were to advance knowledge. PS

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Crosman 38's are used throughout the country in police training.

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**The Crosman Combat "38"**

is a $CO_2$ Pellgun Revolver. It offers single and double action and revolving cylinder which holds six .22 caliber Crosman Super Pells. Cost of the "38" is about $34.50.

**Mark I Target Pistol.**

Shoots .22 cal. pellets. Efficient single-shot action for accuracy. New easy loading. Also available is Mark II. It is designed to shoot .177 cal. pellets and BBs. Either sells for about $26.95.

**Model Sa6. Single Action, 6-shot-Revolver. Authentically-styled western**

gun holds six .22 cal. Crosman Super Pells in a revolving cylinder. $CO_2$-powered. About $21.95.

**Model 600, 10-shot Semi-Automatic.**

This $CO_2$ Pellgun Pistol fires 10 .22 caliber Super Pells in less than three seconds. One of our finest target pistols. Retails for about $34.50.

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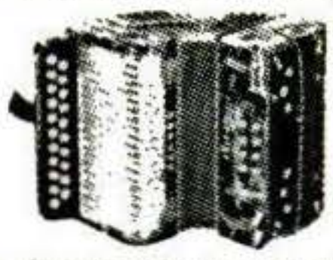

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## New bulletproof shield for lawmen

A policeman models a new bulletproof shield that stopped all bullets fired at it by handguns, including high-speed, semi-jacketed .357 magnum, .44 magnum, Luger parabellum slugs, and 12-gauge shotgun fire from five yards. It's made by Davis Aircraft Products, Northport, N.Y.

## Husky swamp crane has a big reach

This German-built mobile crane was designed for work in swampy areas. Huge balloon-tired wheels almost float it over muddy bogs. A swiveling telescoping arm can lift 4½ tons, and is especially useful in pulling out badly mired vehicles, as shown in the photo above.



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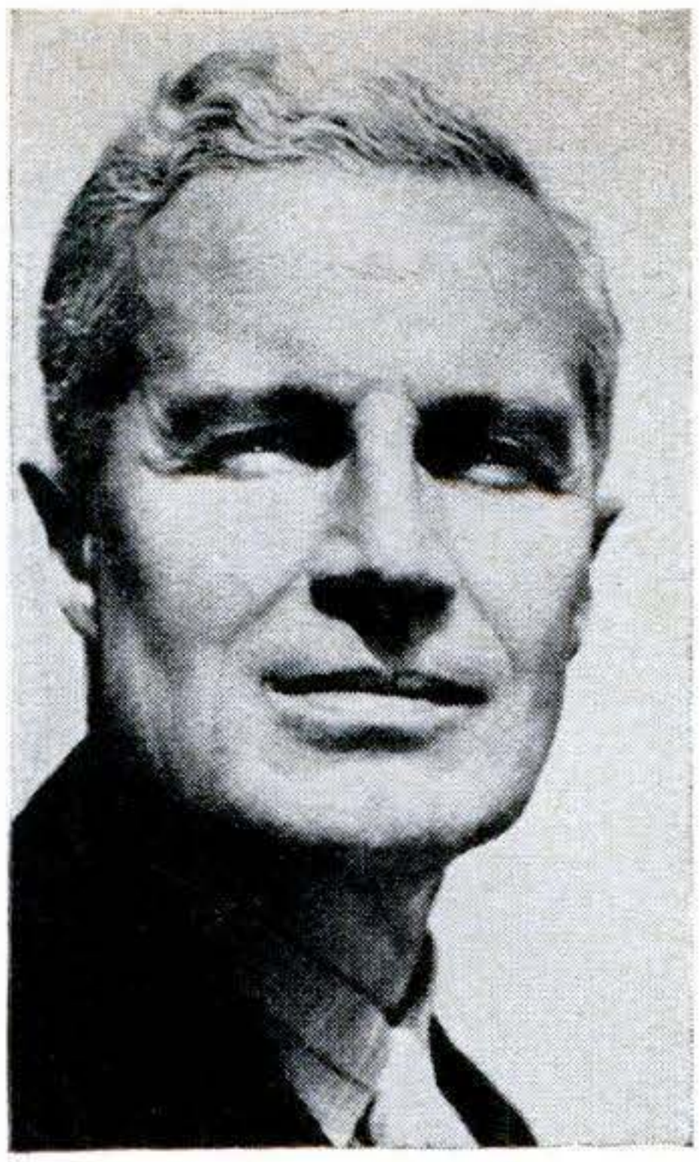

# I'd like to give this to my fellow men...

## *while I am still able to help!*

**I was young once, as you may be — today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.**

**By Victor B. Mason**

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

### I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

### A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

### Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

### Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

**VICTOR B. MASON**
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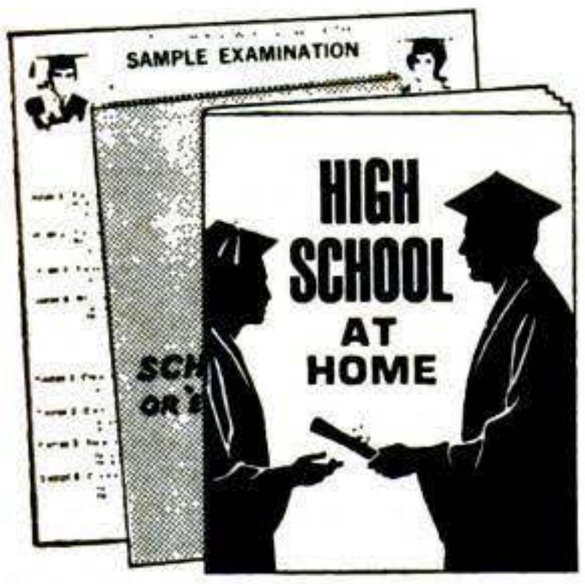


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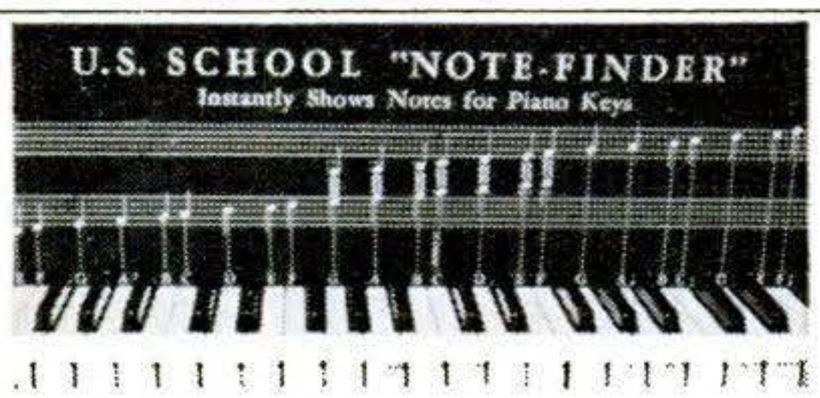


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## Bins make use of waste space

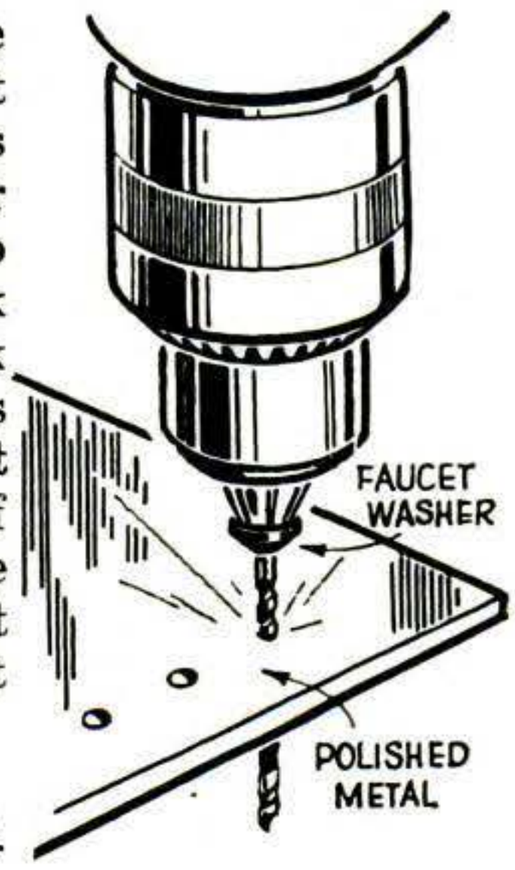
You can take advantage of the shallow space between exposed studs in your garage or storage shed by building small bins. Use scraps of plywood for the angled sides, back, and bottom, hardboard for the front. After butting the bin against the sheathing, fasten by driving a couple of 10-penny nails through each side into the studs.

A. L. RAMOS, San Anselmo, Calif.

## Rubber washer protects workpiece

If you slip a rubber or Neoprene washer over the bit when drilling holes in polished metal or veneer, there's no chance of the chuck marring the work when the bit breaks through. Ream out the center hole if necessary so the washer fits the bit tightly when against the chuck.

V. LAMOY, Upper Jay, N.Y.



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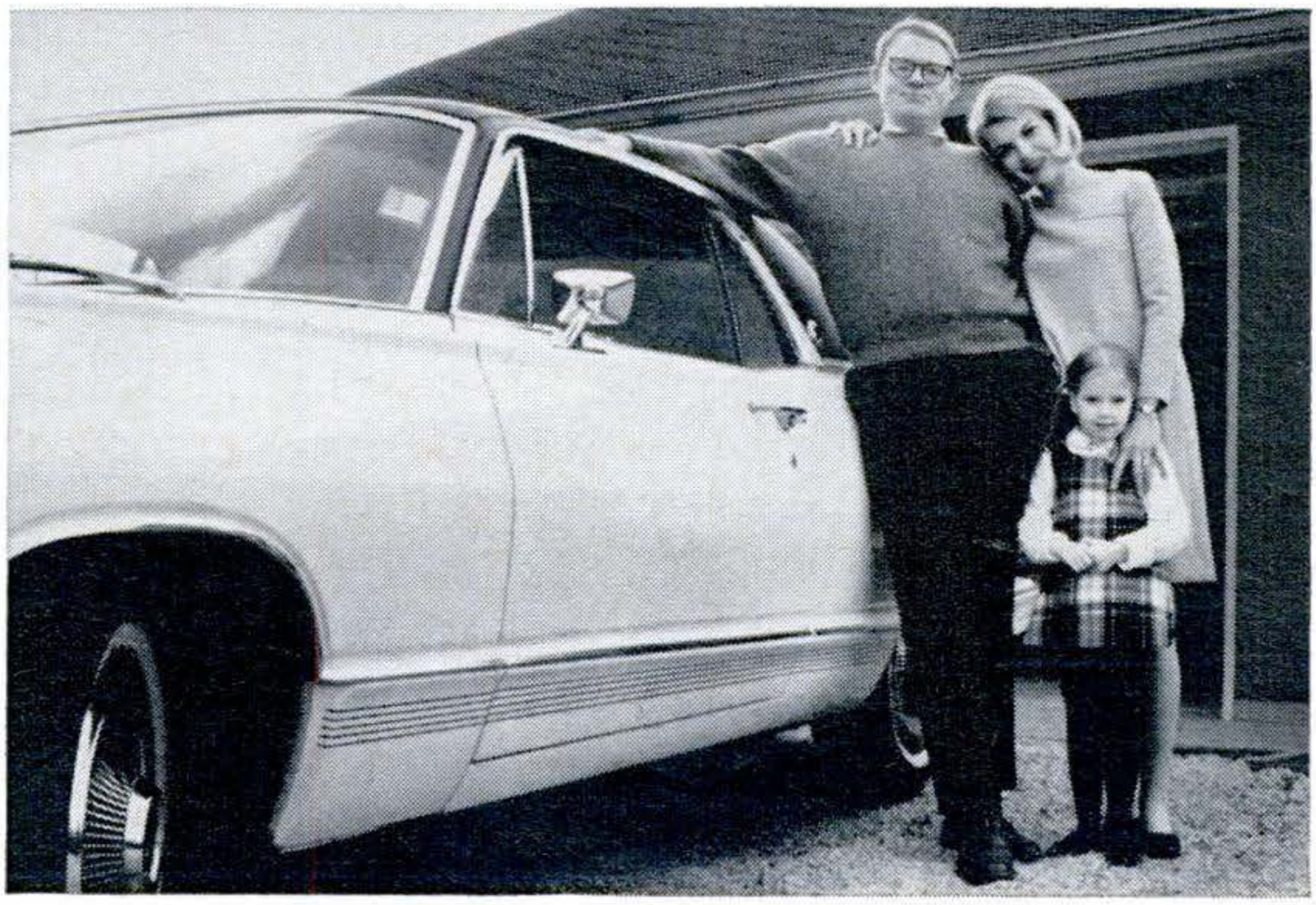
# How old will your car be five years from now?



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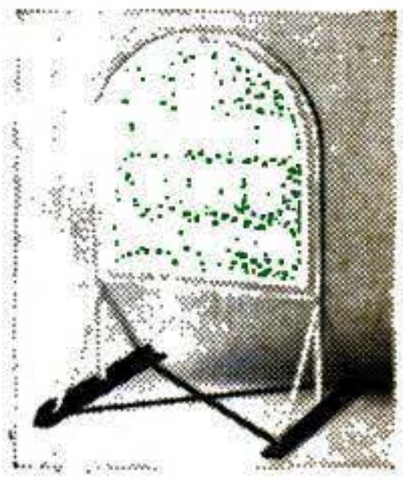
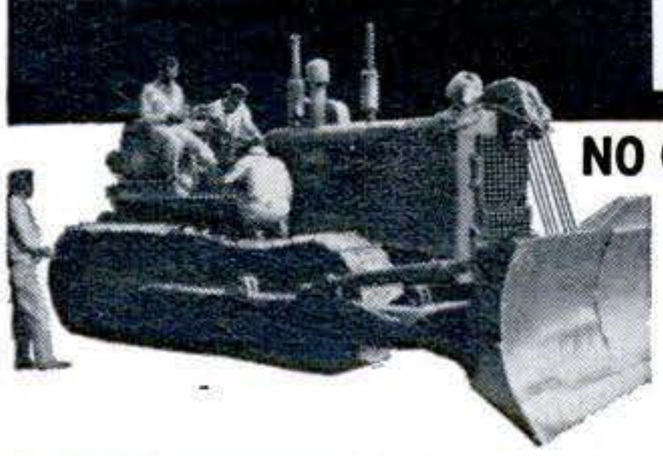


Quaker State your car will keep running young.

# LEARN TO EARN!



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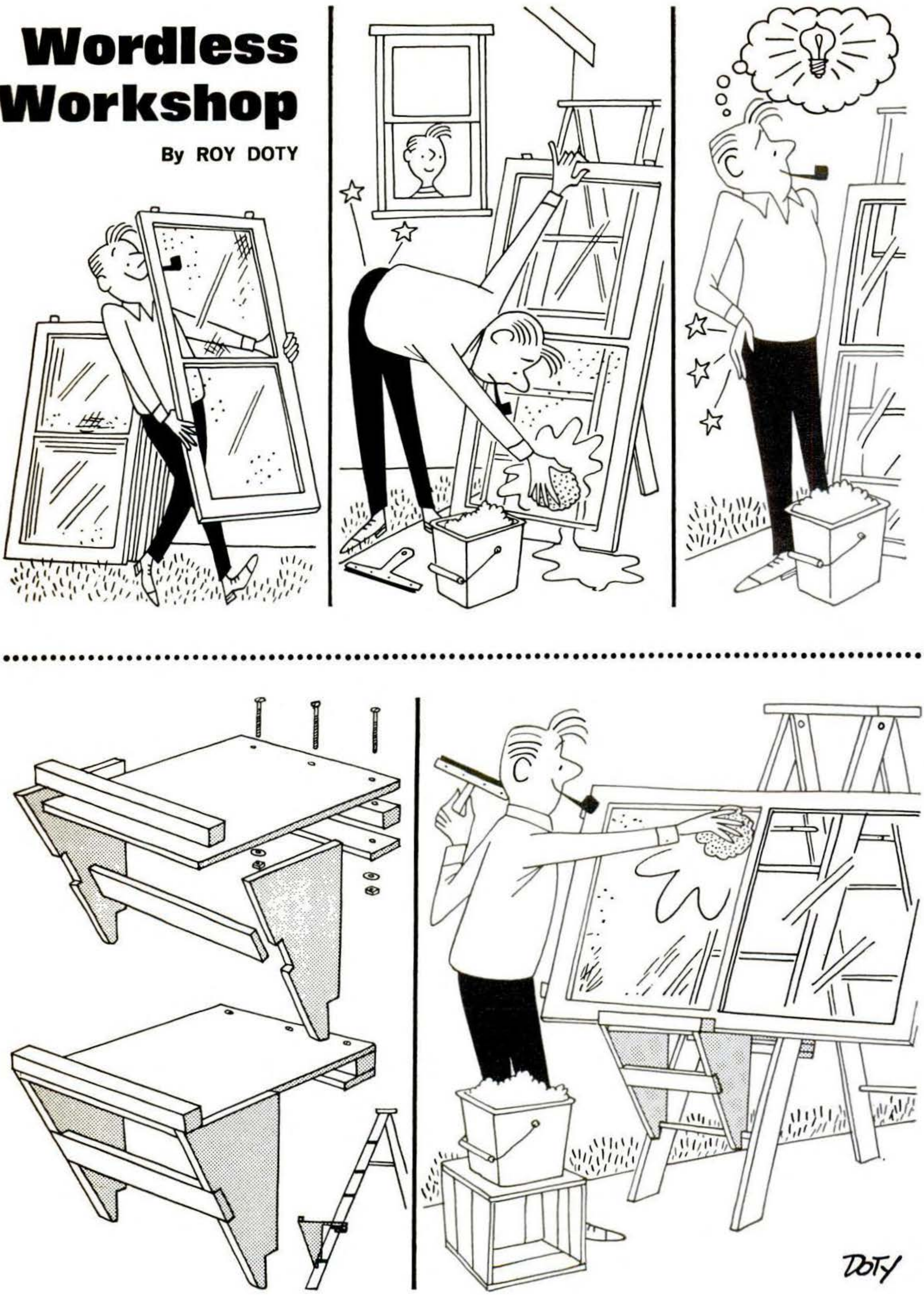
By ROY DOTY



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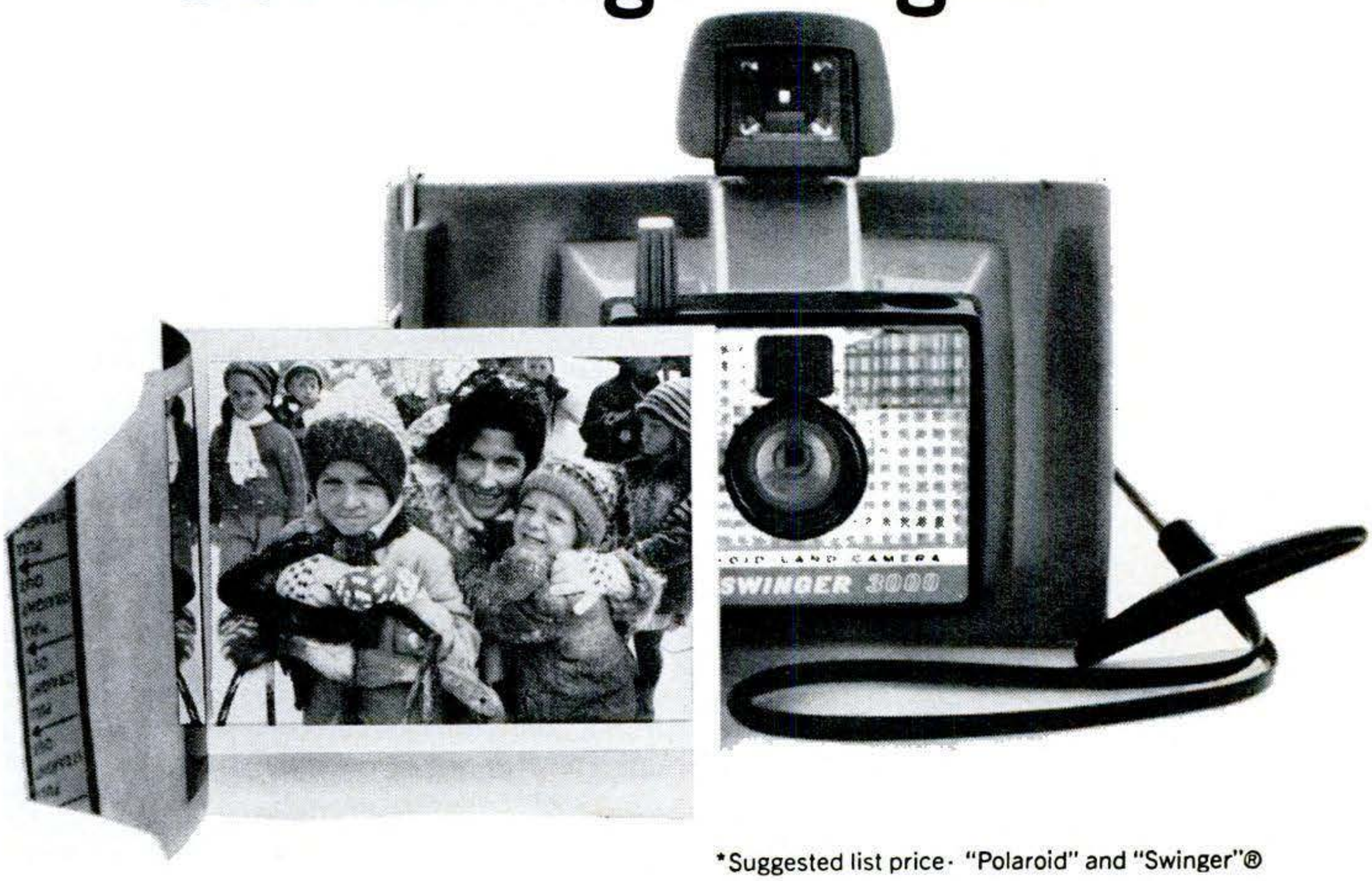


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# Detroit Report...

FORD PLANS TO STARTLE THE AUTOMOTIVE WORLD with a second new small car. This one, being developed under the code name Phoenix, will be even smaller than the Maverick (code name Delta) and is scheduled for introduction sometime in the 1971 model year. Phoenix is seen primarily as a direct attack on the smallest imports. Ford has a second reason for developing Phoenix. It will be ready to compete with the new Chevrolet Chevette when that mini-compact is introduced in 1971.

**Ford's subcompact Maverick** will be sold by both Ford and Lincoln-Mercury dealers when it is introduced next spring. Ford raised its sights on the selling of this car, and changes in prototype models reflect the growing confidence of the company in its future. Finished prototypes sport vinyl roofs, V-8 engines, and other extra-cost items that tip off Ford's merchandising plans. The car will basically have a bench front seat for three passengers. The rear seat will only hold two. Bucket seats will be offered up front at extra cost. Instruments are deeply recessed in three circular housings directly in front of the driver, a la Camaro.

**Some subtle changes** in Chrysler Corp. 1969 models show the company is listening to and acting on owners' complaints. New steering wheels are one example. The oily feel and look of polypropylene steering wheels are gone on most models, replaced by a richer and more costly butyrate plastic. Instrument panels are lowered slightly on intermediates and compacts in response to complaints from short drivers. Driver's-side door locks can now be overridden by the door handle. A six-way manually adjustable bucket seat is available on some models at half the price of a power-operated one.

**Ford is in a bind** with the Cortina and the Maverick. The company expects to sell about 31,000 Cortinas this year, and has announced plans to sell 50,000 in 1969. But the Cortina will run smack up against the Maverick in April or May. From then on it will be an uneven battle. The cars will not only compete with each other in the marketplace but, even more important, in the dealer's showrooms, where Maverick will have everything going for it. Since the two cars will be so similar in size, and since Maverick will have a price tag of $2,000, it will quickly put a stop to the growth of the Cortina in the U.S.

**Aluminum radiators** will be put on 2,000 Fords in the next 12 months. They are being built on a small pilot assembly line in Dearborn to prove out costs and reliability before Ford makes a final decision on full production. So far, results on aluminum radiators in service have been mixed. For the most part, they do the job, but repairs are tricky. If an aluminum radiator leaks, it is replaced with the normal copper type. This is true of production Corvettes as well as experimental cars. Two big reasons for the aluminum push are lighter weight up front and a better supply situation.

**Maverick, Challenger**—proposed names of cars that will be announced within the next 10 months—are still tentative. Auto companies wait until the last minute before finally deciding on a name for a new car. The decision is a painstaking affair that involves long hours of research. At this date, Dodge is still not firm about the name Challenger. Ford likes Maverick for its subcompact, but if the car is marketed as the 1970 Falcon two-door, Ford would have to call it the Falcon-Maverick. And that is not the simple, hard-hitting brand name sales executives like. Best guess is that Ford will eventually make Maverick in a number of models, and create a separate car line based on the Falcon.

**Chrysler is secretive** about its small-car plans, but the company seems to be leaning to the idea of using its own imports—Simca and Sunbeam—to get a bigger share of the subcompact market. Ford's plans for a massive attack on that market with Maverick and Phoenix, and Chevrolet's plans for the Chevette, may change Chrysler's mind.

Jim Dunne

Detroit Editor



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# An untuned car is "won't start" trouble

## This winter, more cars won't start because of worn spark plugs than old batteries.

Worn spark plugs can give you more starting trouble than your battery? You'd better believe it. Especially in winter.

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Cover the last five lines of this caption, and see if you can figure out what the gent pictured above has on his face. It's a mask for outdoorsmen, heated by a tiny nickel-cadmium battery that warms inhaled air to 65 degrees. He needs it—he's about to start ice-fishing. Shavex Corp., Elk Grove, Ill., markets the mask.

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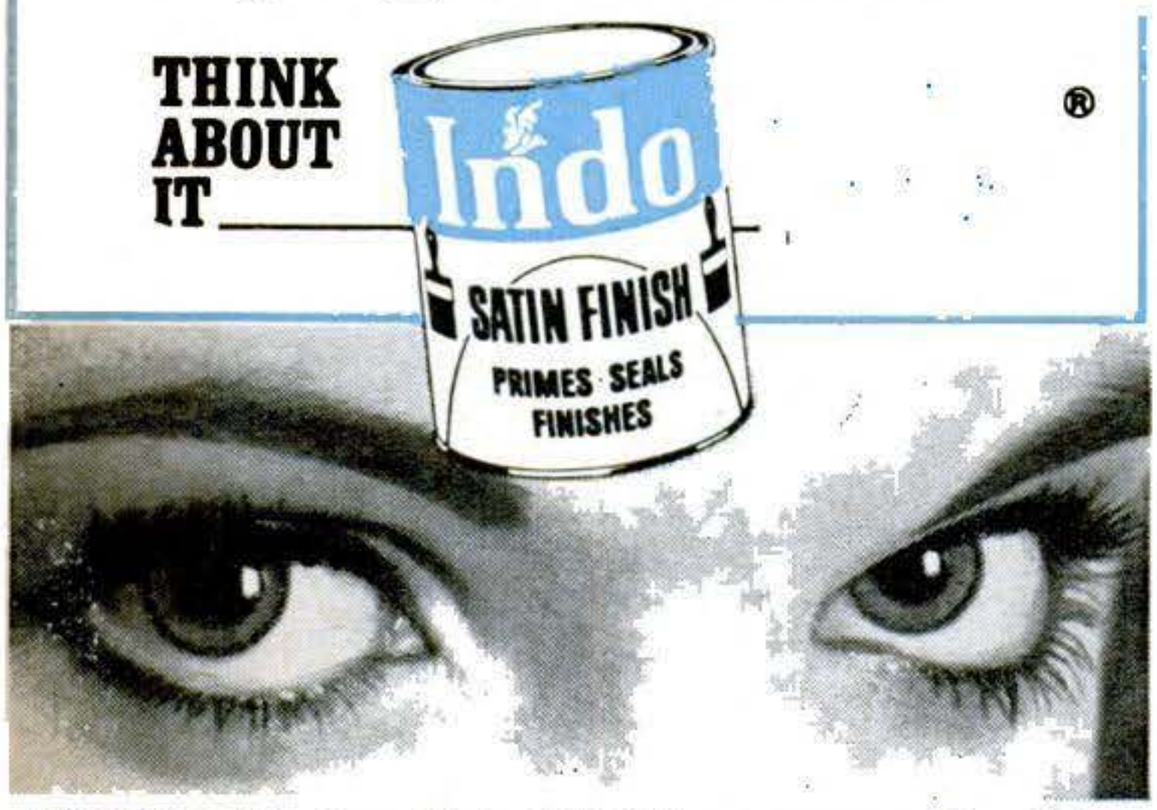


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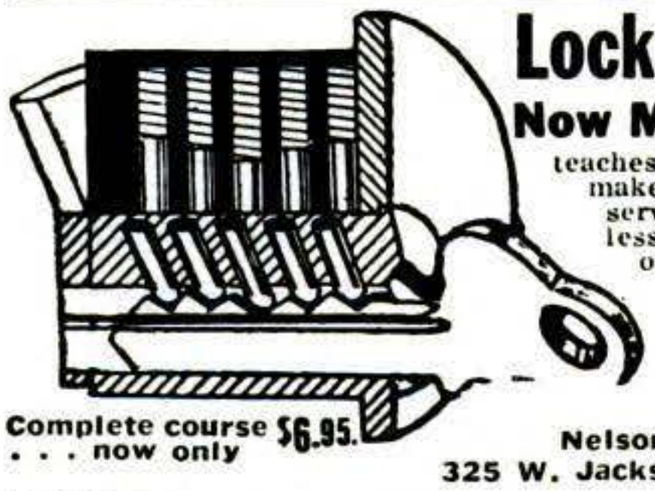

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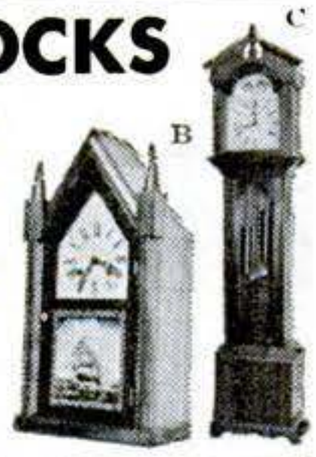


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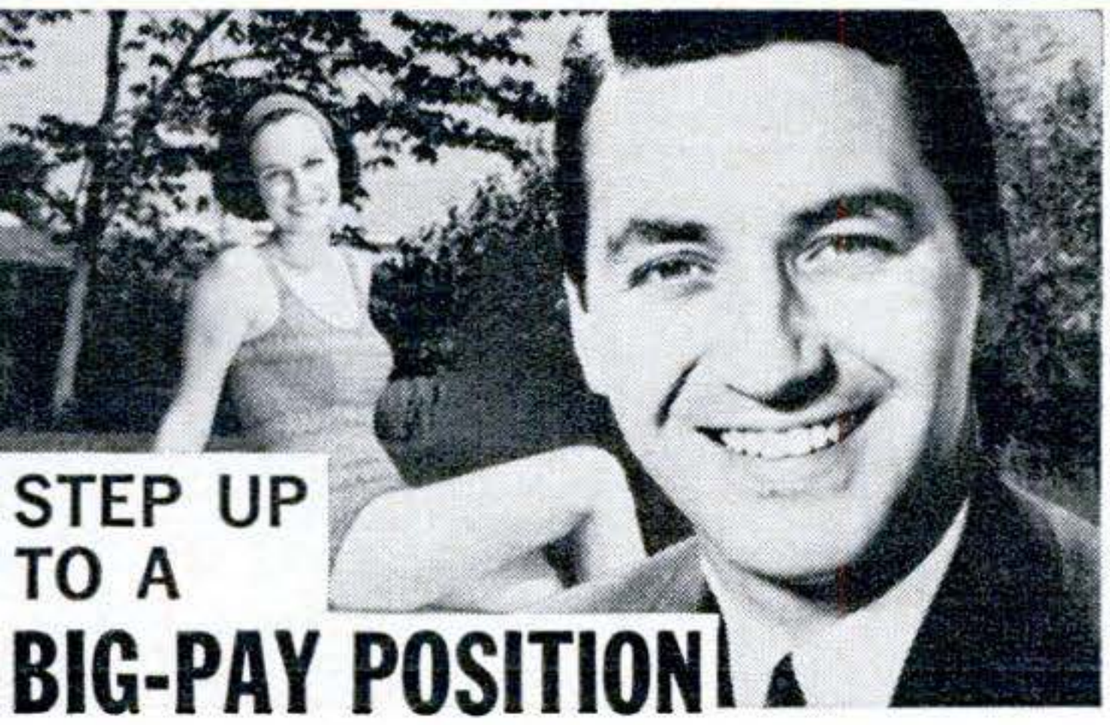

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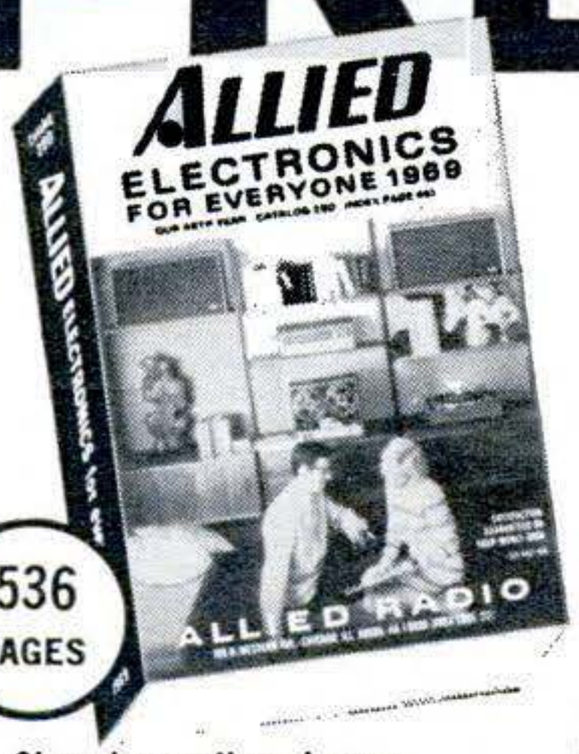


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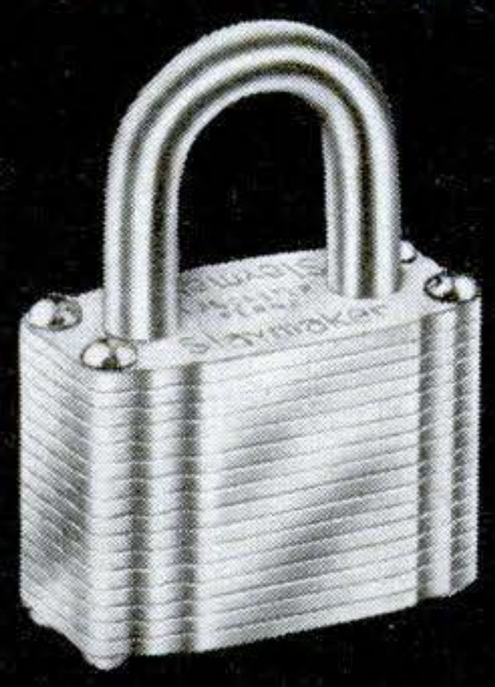

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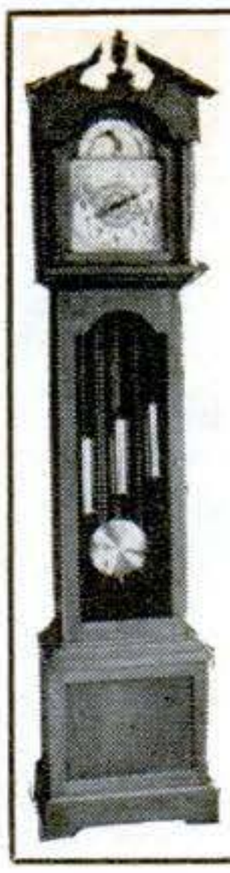

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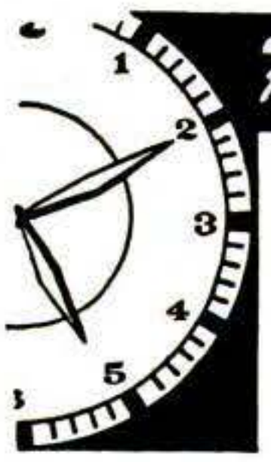

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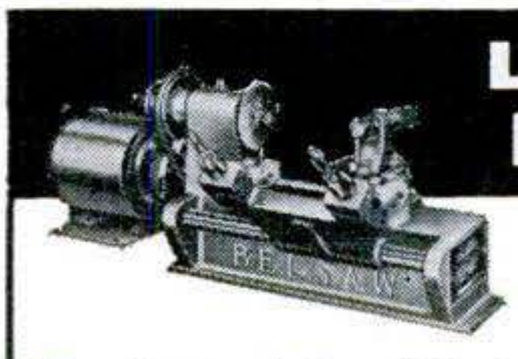

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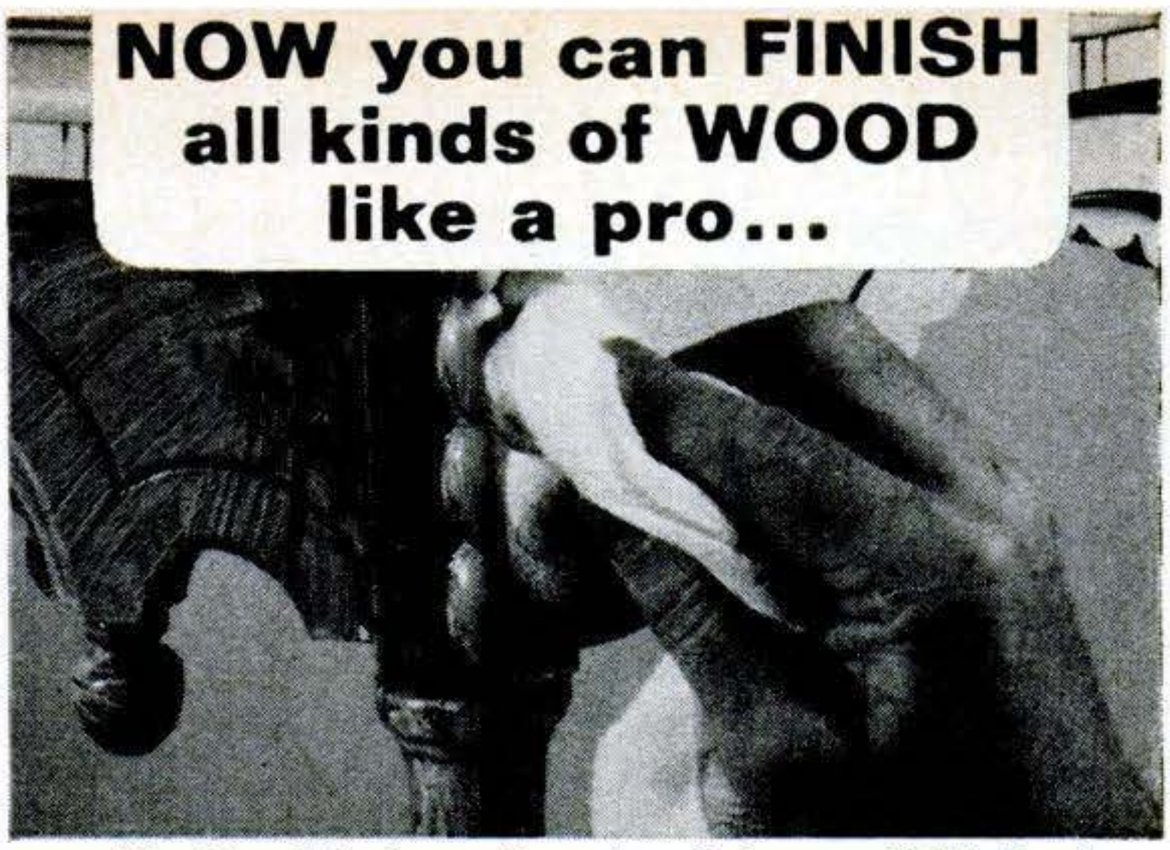

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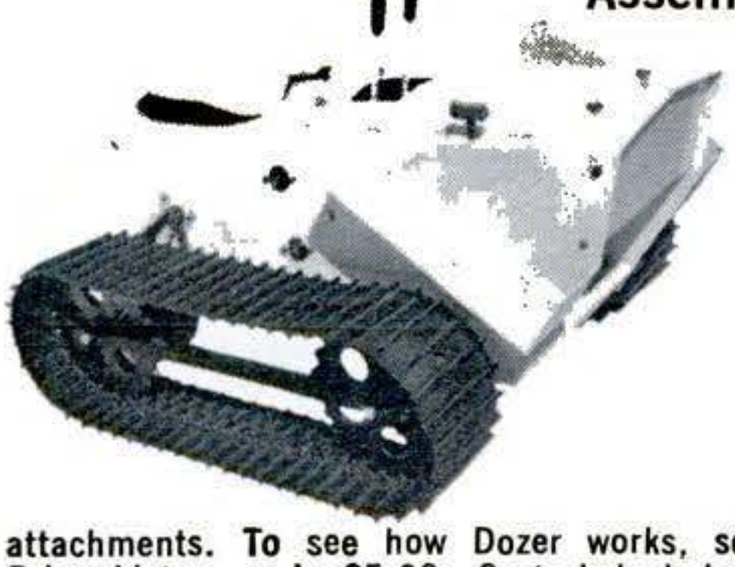

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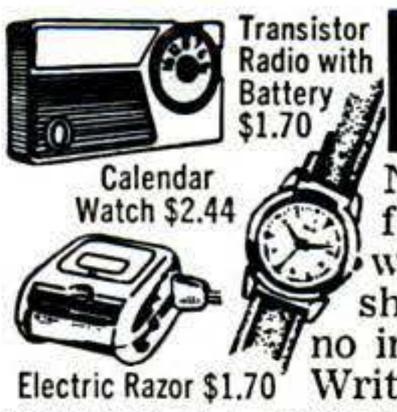


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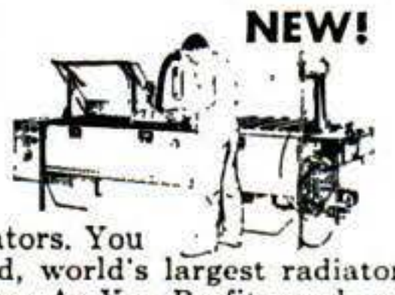


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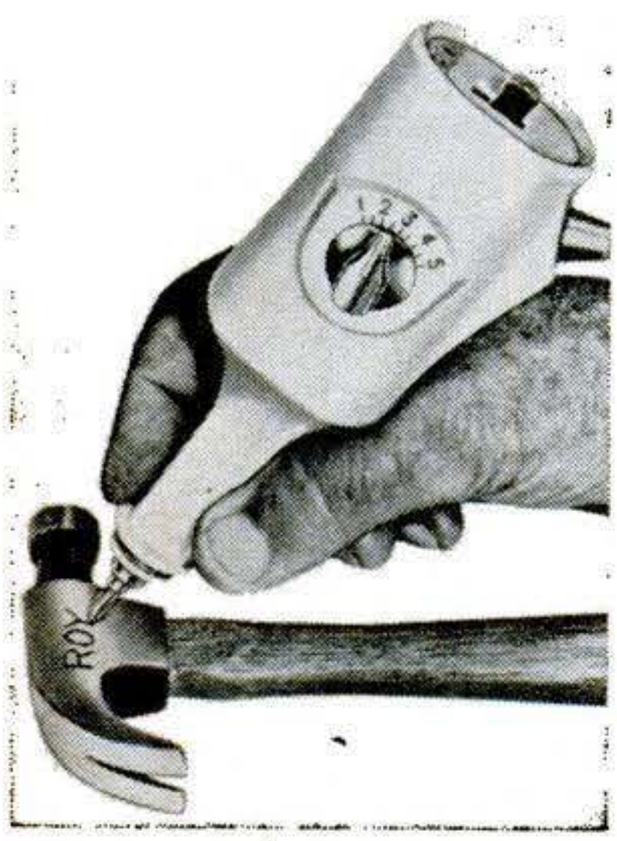


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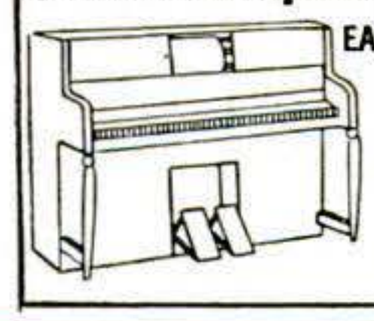

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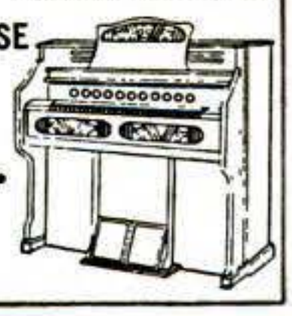

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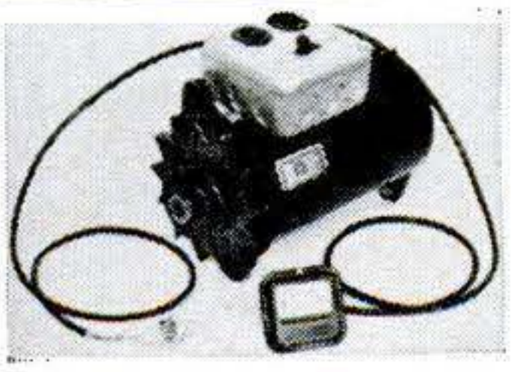

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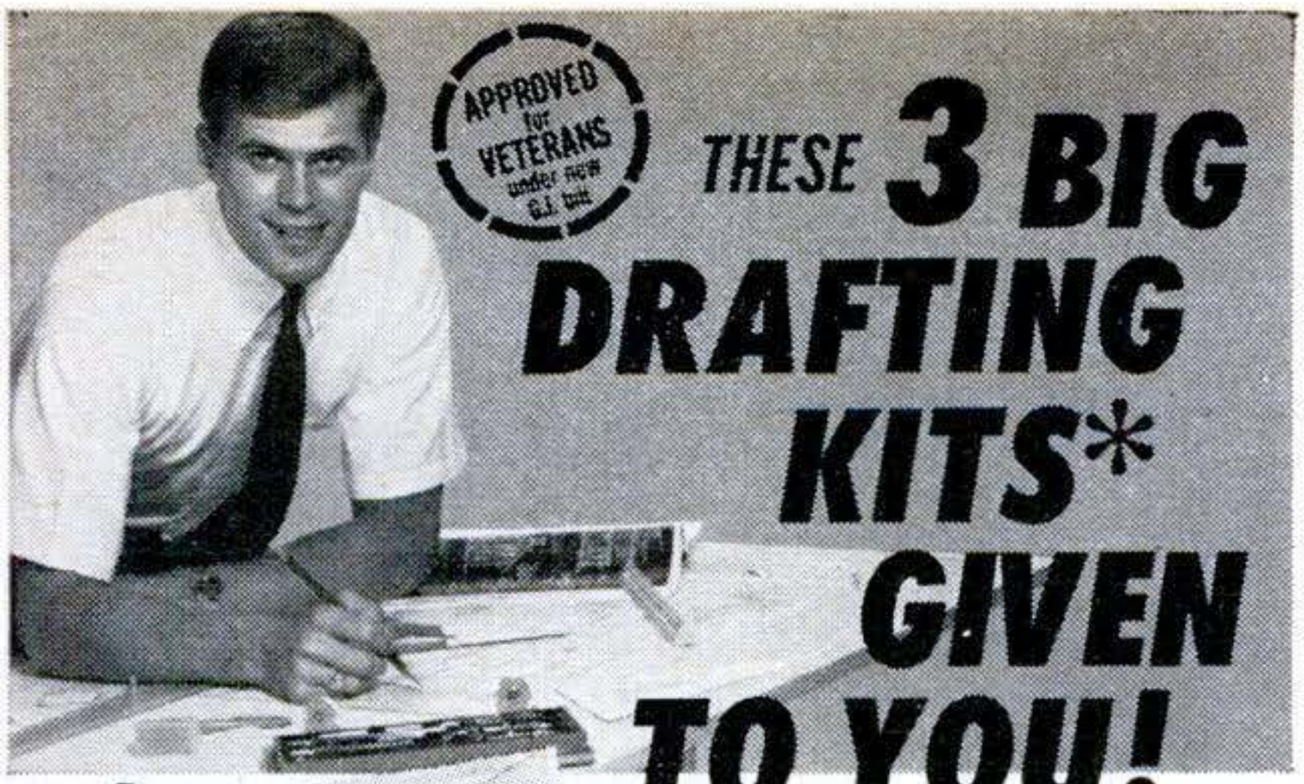


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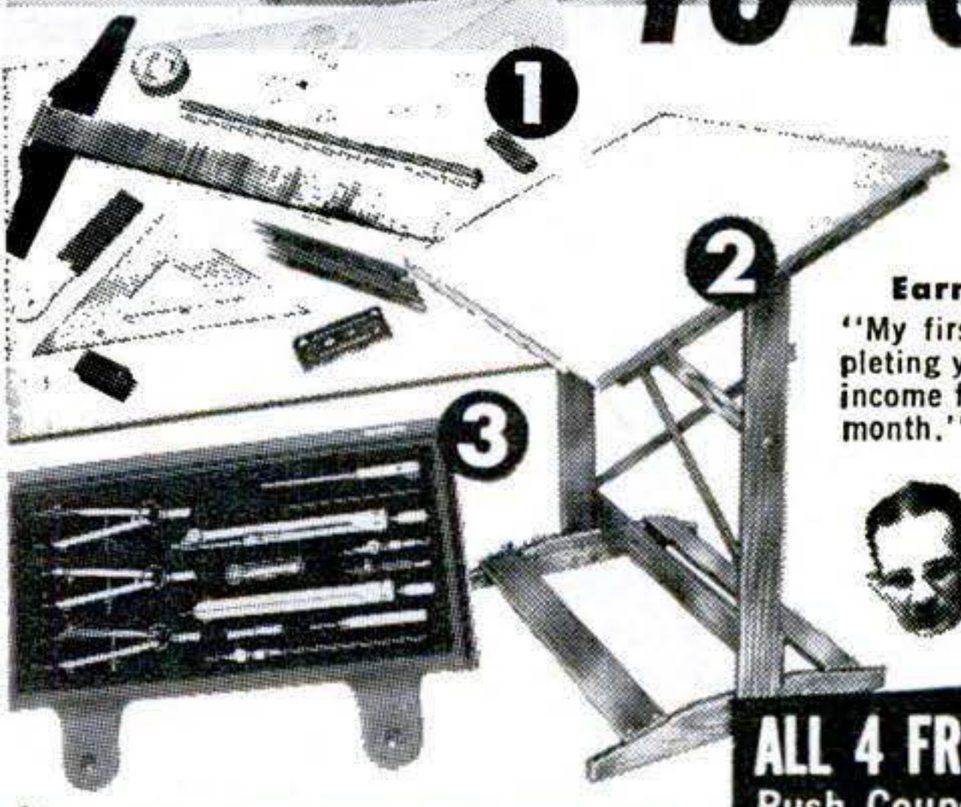


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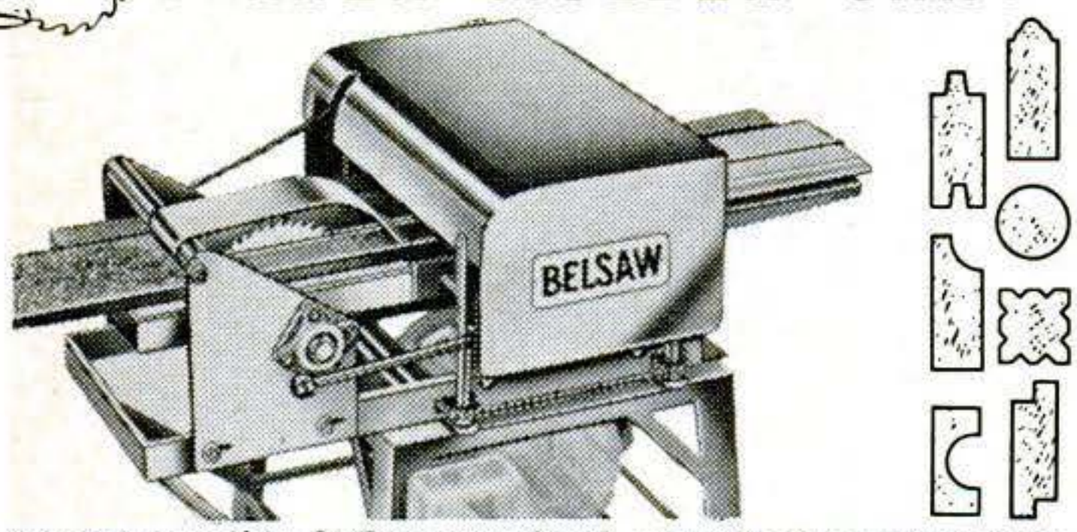


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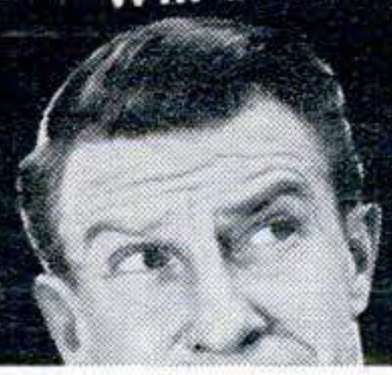

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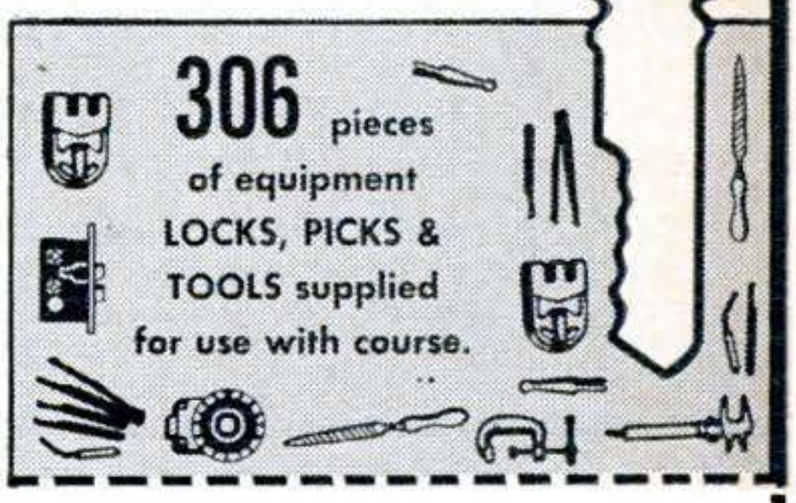


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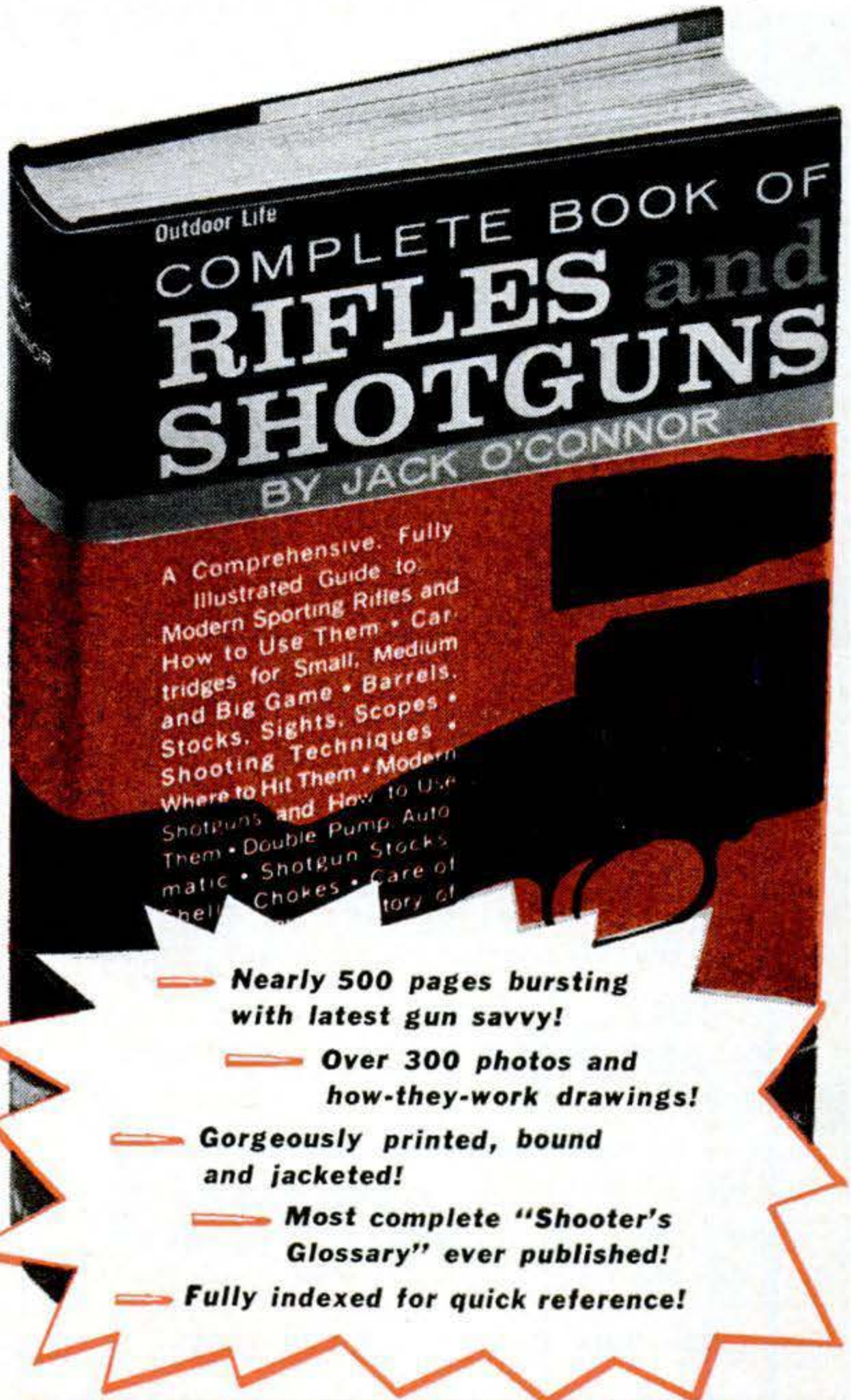


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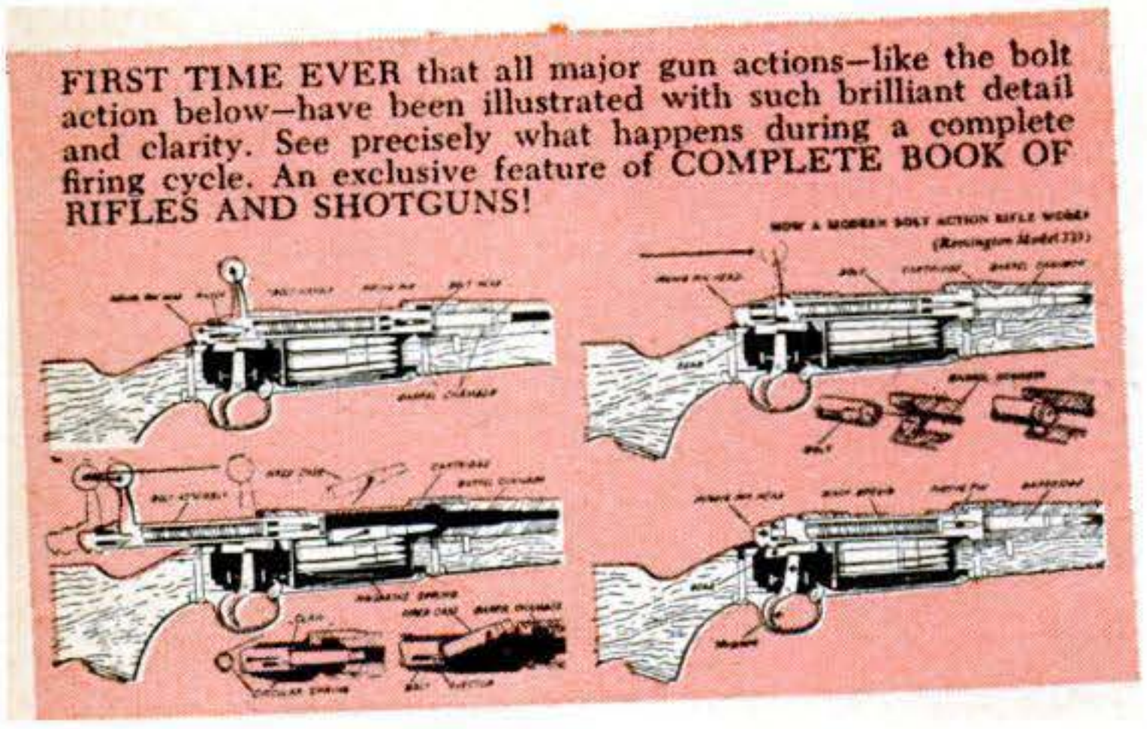

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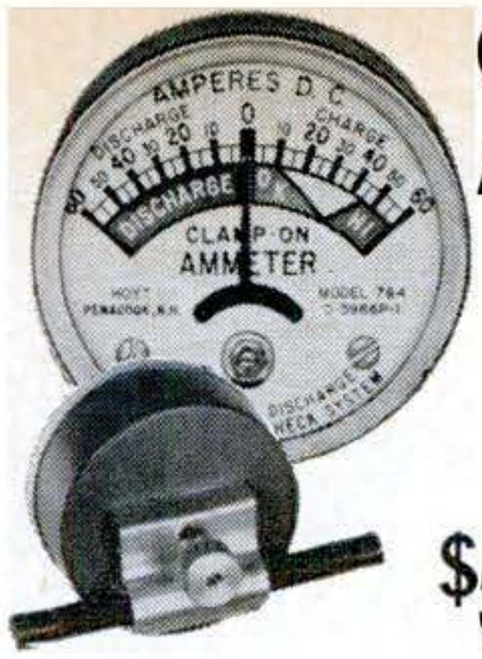


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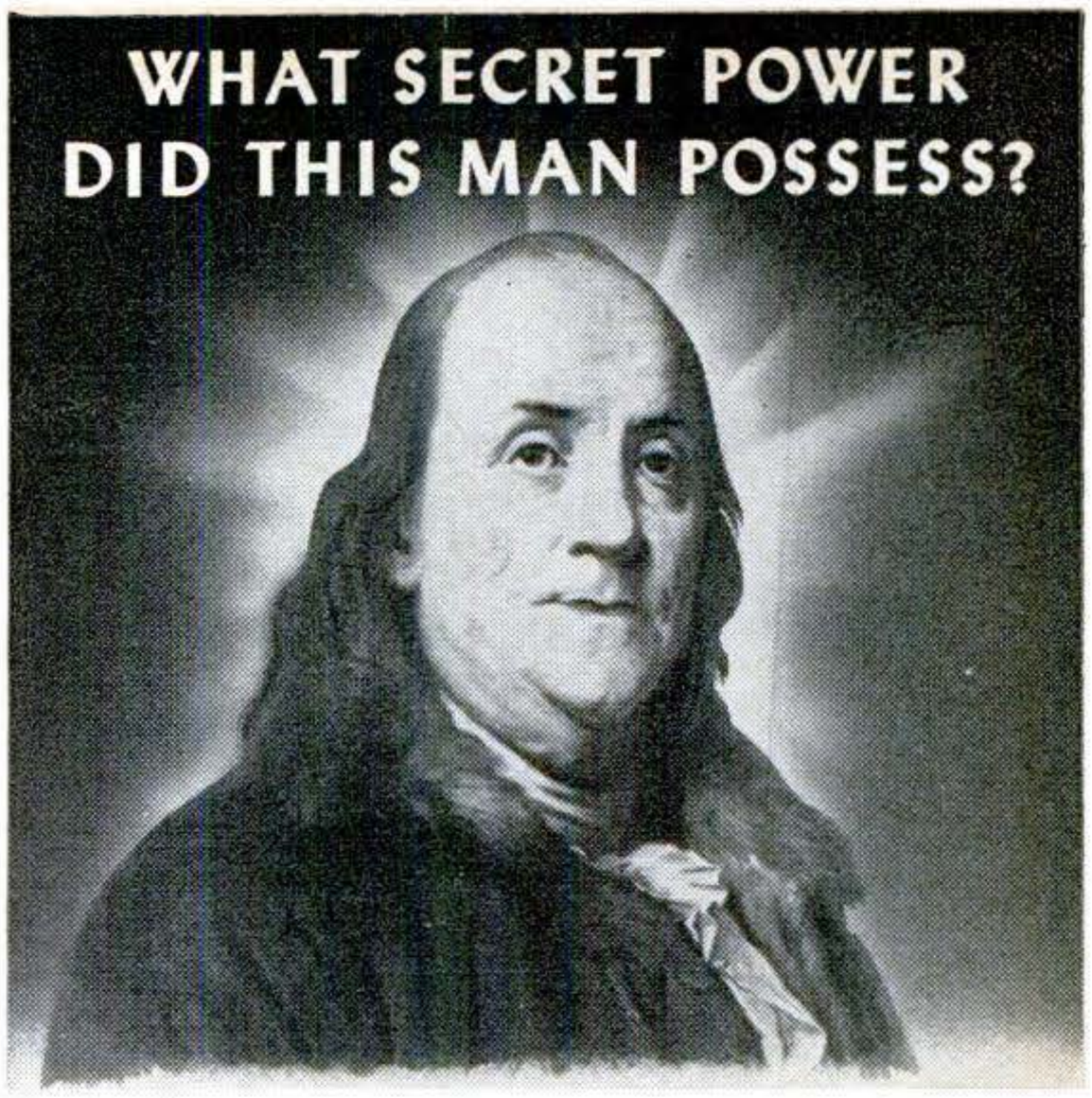


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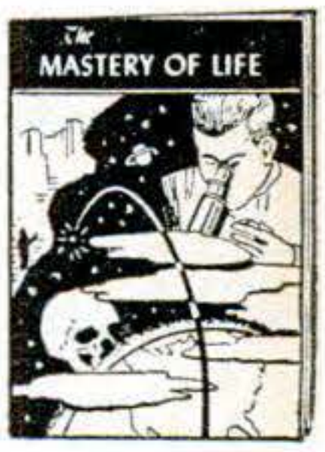


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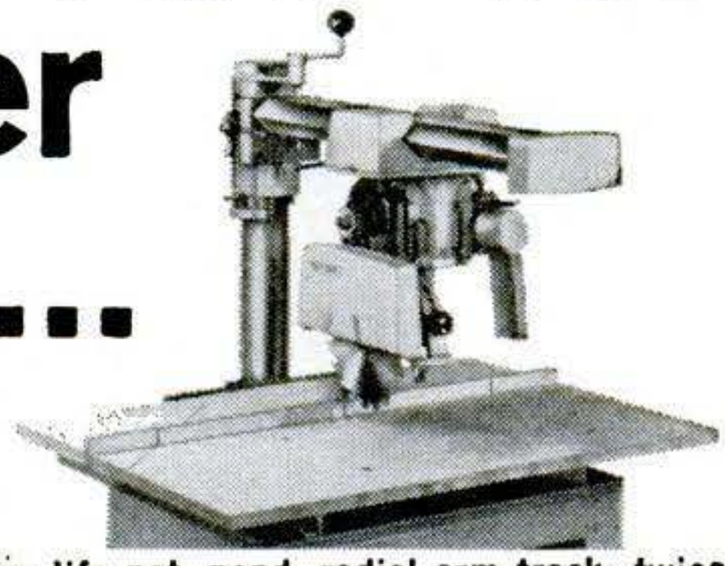

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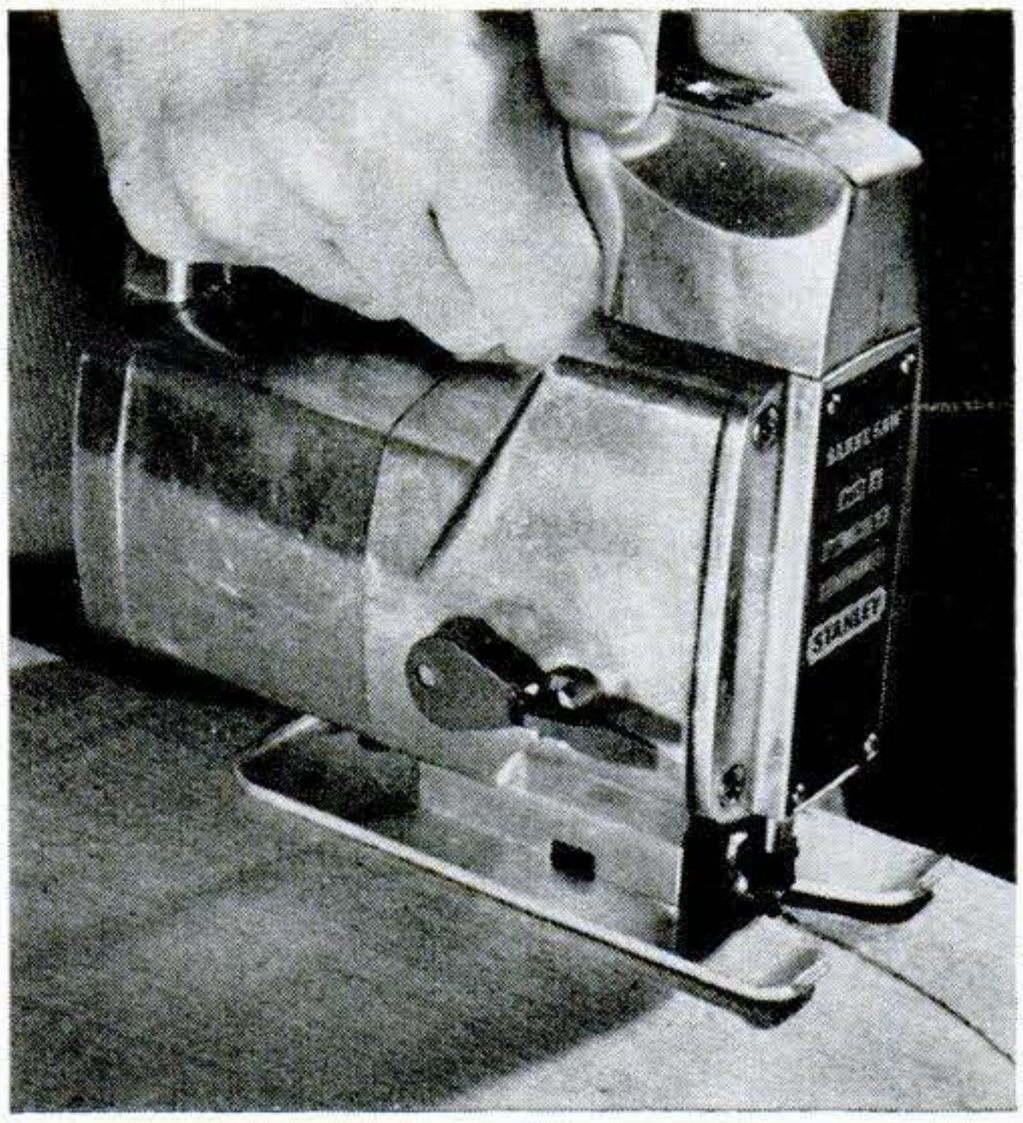
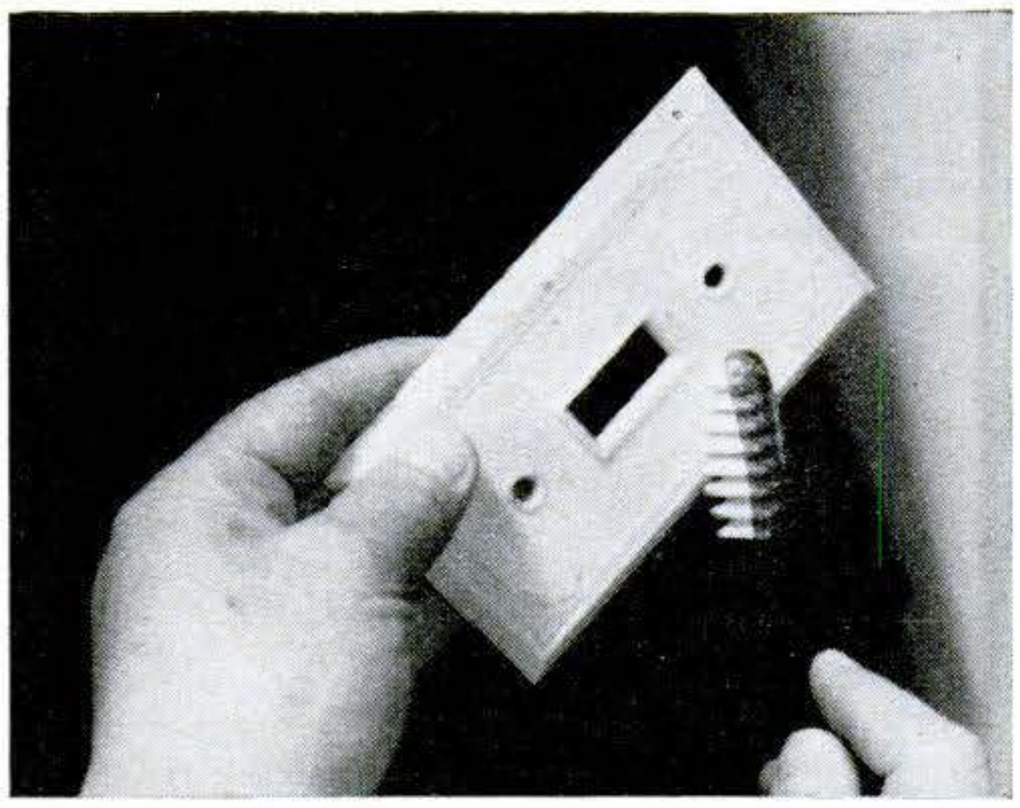


## Magnet keeps tools within reach

When using a saber saw, a screwdriver (or Allen wrench if your saw requires one) is not always nearby when you want to change blades. This is especially true on away-from-the-workbench jobs. By welding or epoxy-cementing a small magnet to the saw housing, the small screwdriver or wrench is always ready for use.

W. B. SILL, NYC



## Quick way to clean outlet covers

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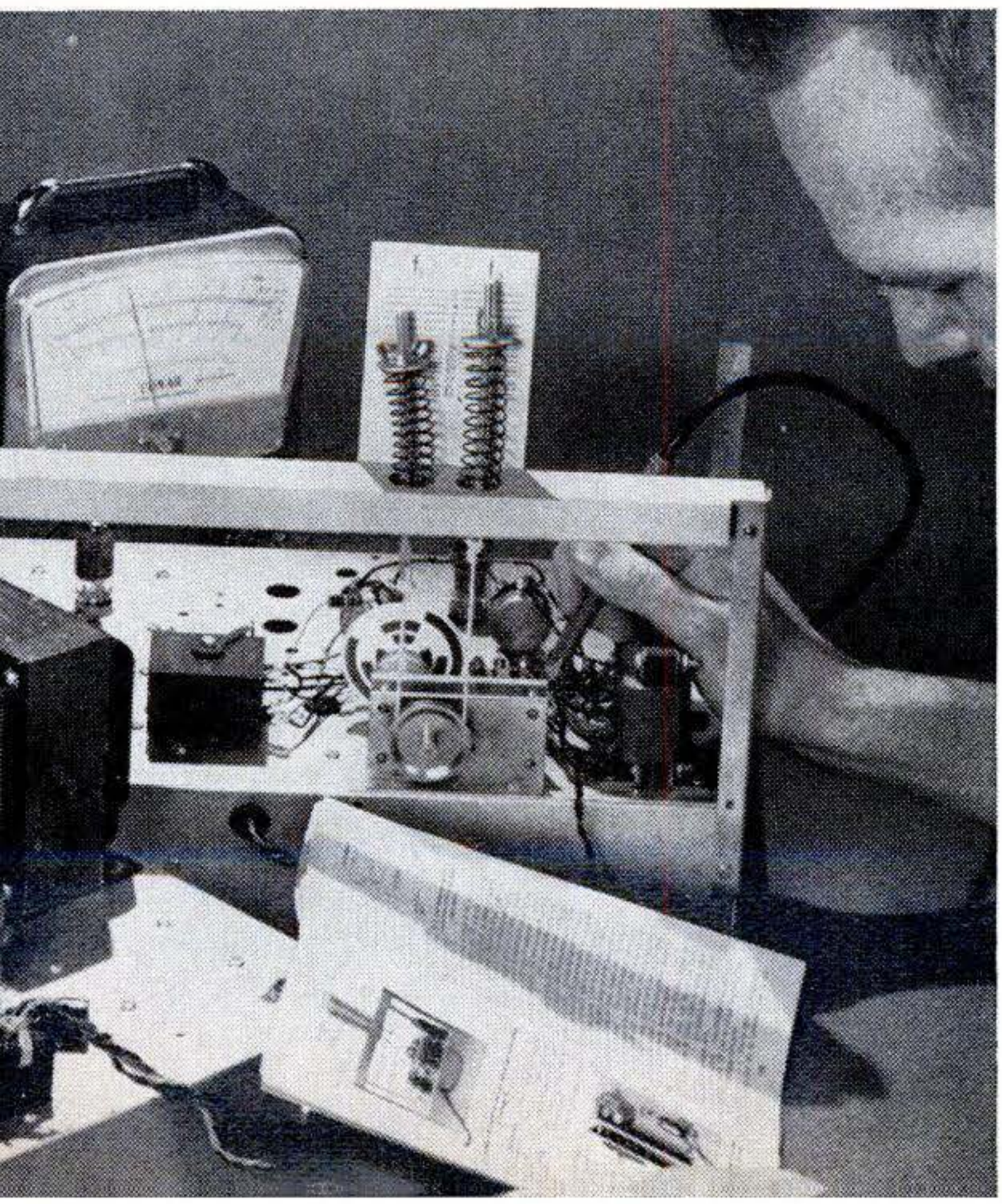

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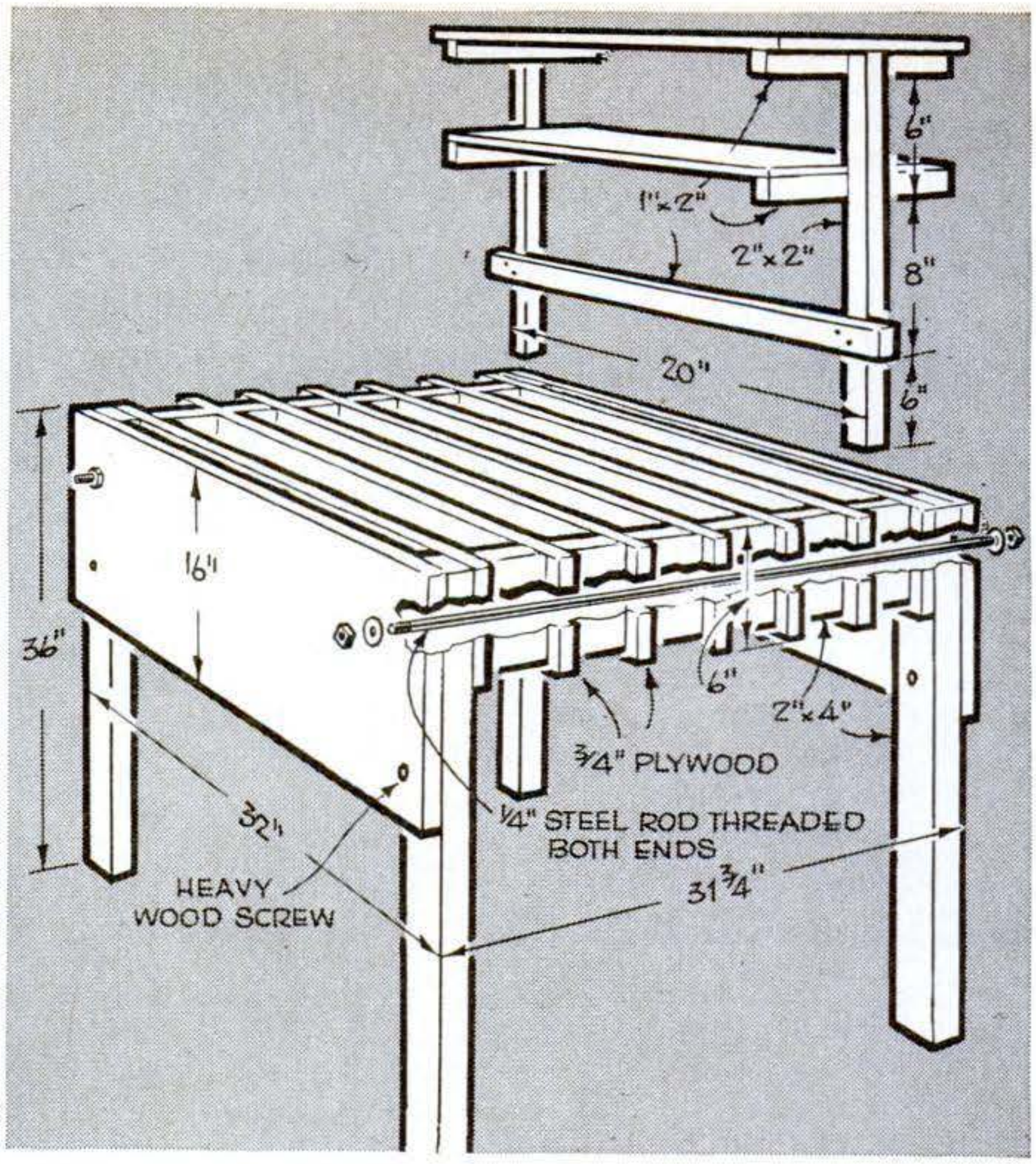
SHORT CUTS AND TIPS

FROM HERE AND THERE

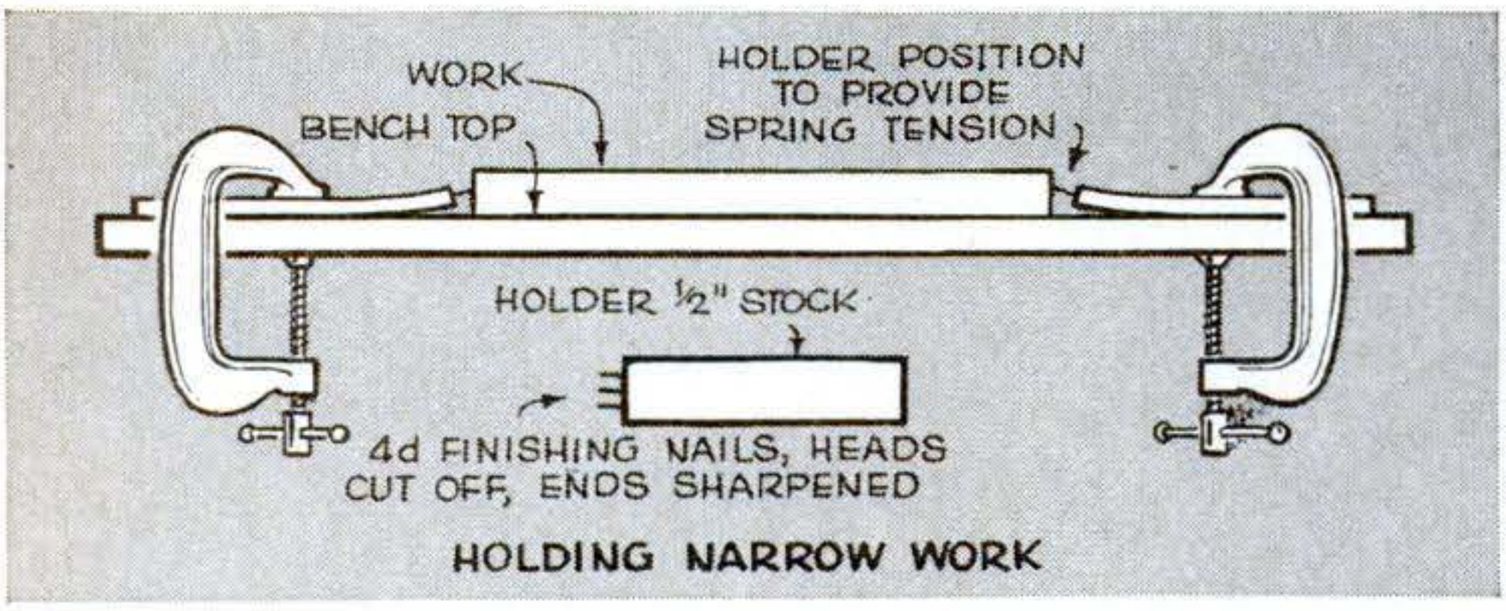


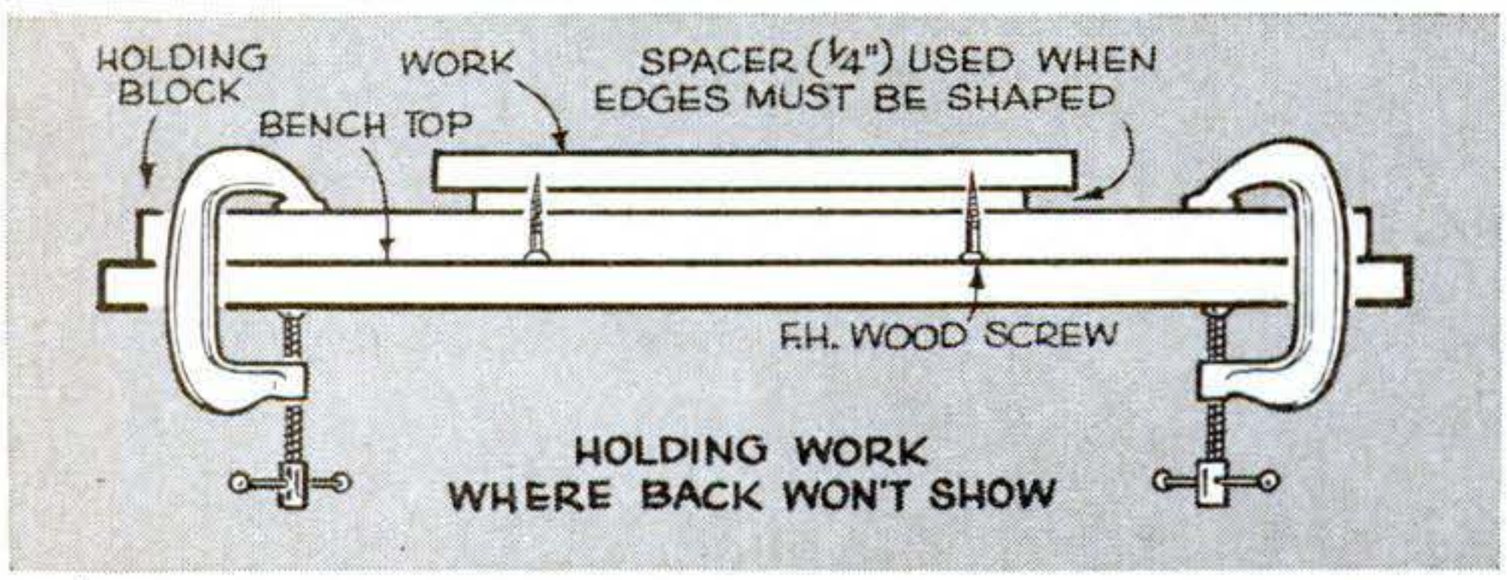

## Self-cleaning workbench for messy jobs

A worthy addition to any shop, this bench is designed to handle tough-to-clean-up chores such as removing panes of glass, stripping paint, and soldering. As you work, debris drops, or is brushed, through the grid-like top into a conveniently placed trash receptacle below.

The bench is made of lengths of 3/4" plywood on edge, plus spacer blocks and legs cut from two-by-fours, all fastened together with two lengths of threaded rod. To increase stability, a plywood apron is attached on two sides. The double-tiered removable rack is optional—but handy—for holding tools, parts, and supplies. If desired, it can be notched or drilled to serve as a rack for holding your special-purpose tools.

D. Corey, Binghamton, N. Y.




## Two work holders for your routing jobs

You can do a better—and safer—routing job if both hands are kept on the tool. For shaping narrow stock, make the "spring" hold-downs (top sketch at left) using strips of 1/2" stock. Position them to create holding tension as nails bite the wood. The second version is for surface and edge routing when the back of the workpiece will not show. The spacer is needed for edge work only to keep the cutter off the bench top.

William Booth
Glen Ellyn, Ill.



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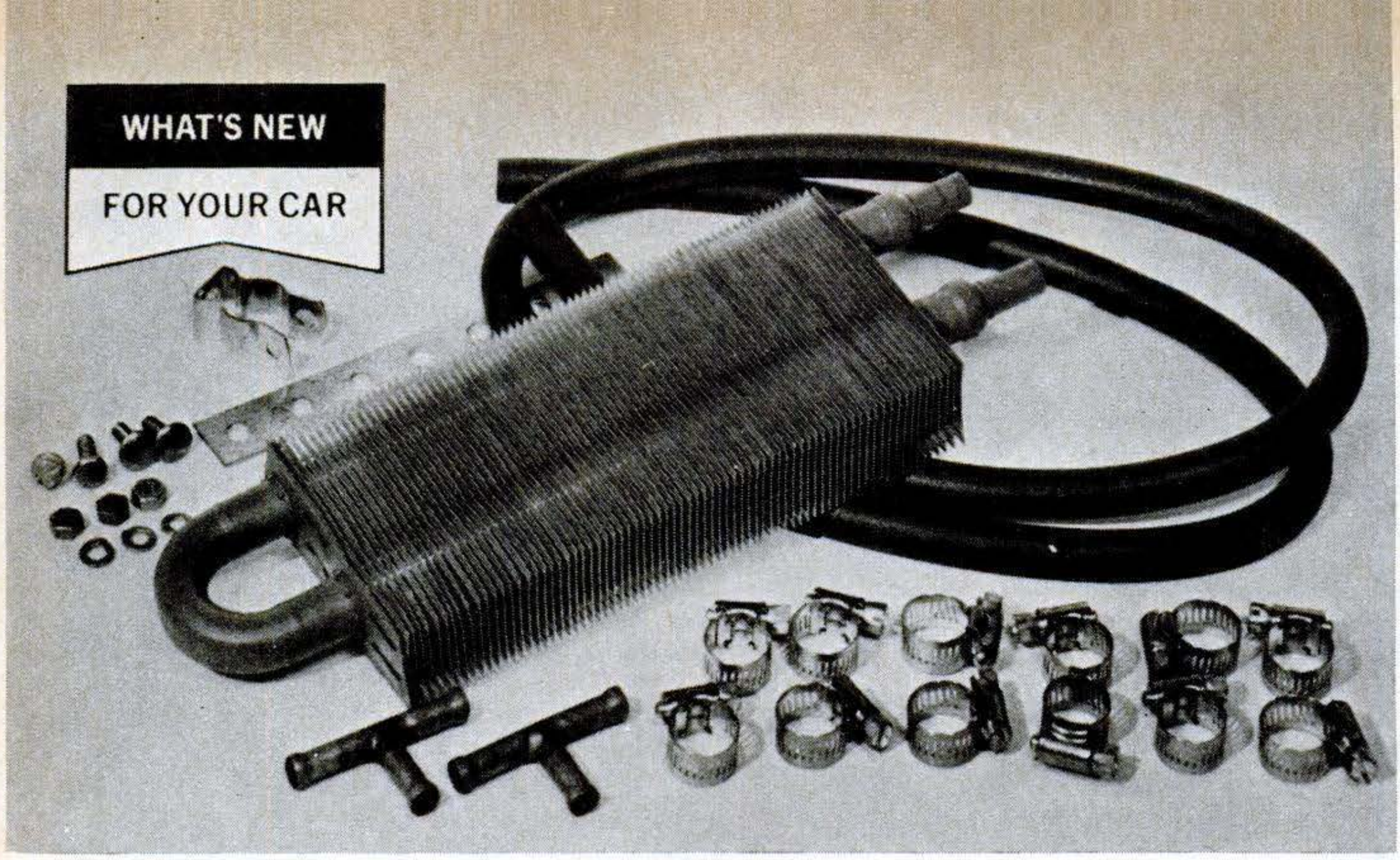



## Trans-Cooler protects transmission

Stop-and-go traffic or trailer towing throw extra-heavy loads on your automatic transmission. It may overheat (with transmission-fluid temperature as high as 350 degrees, against a normal 200-280), and permanent damage may result. A Hayden Trans-Cooler can be installed in parallel with the original oil cooler or be fitted in its place—usually under the main radiator. Valley Tow-Rite, 27 E. Vine St., Lodi, Calif. 95241. About $30.

### Shell E-C additive now in snap-open can

Shell's E-C concentrate is an oil additive formulated to reduce oil-burning and exhaust smoke, clean and silence hydraulic valve lifters. Available in Shell stations, the E-C concentrate comes in snap-open cans with a prefitted aluminum ring.

### Rugged Trailer-Jak gives quick lift

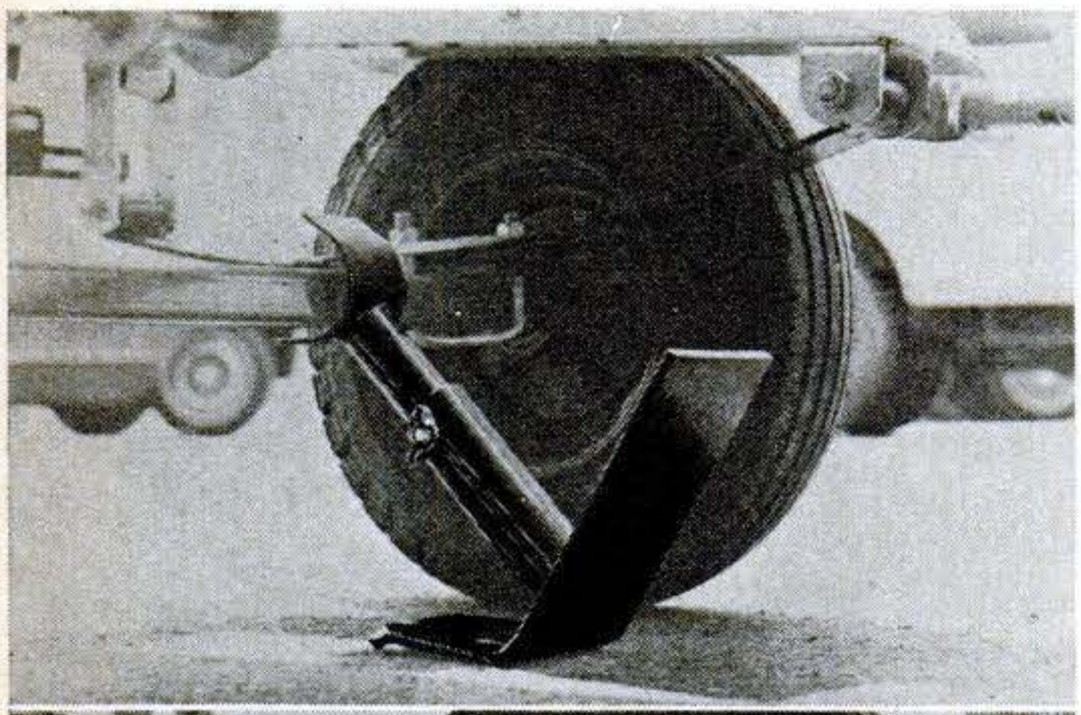
Place in position, tow forward, and the trailer is up on two wide-base props, adjustable for height. $9.95 each. Central Specialties, 6032 N.W. Highway, Chicago, 60631.

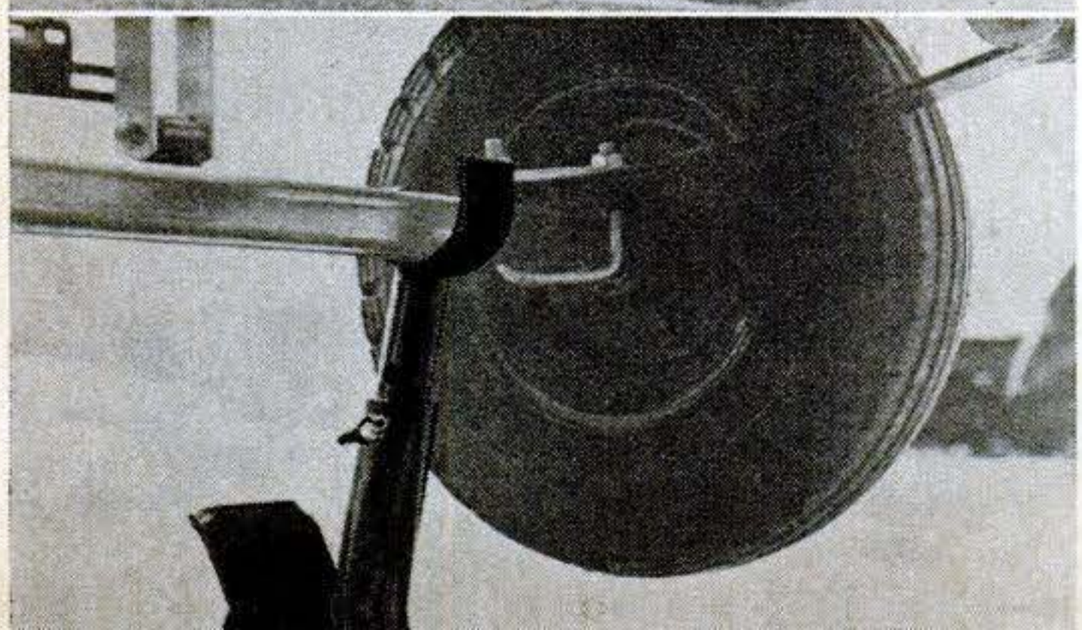
### Stop oil leaks from the outside

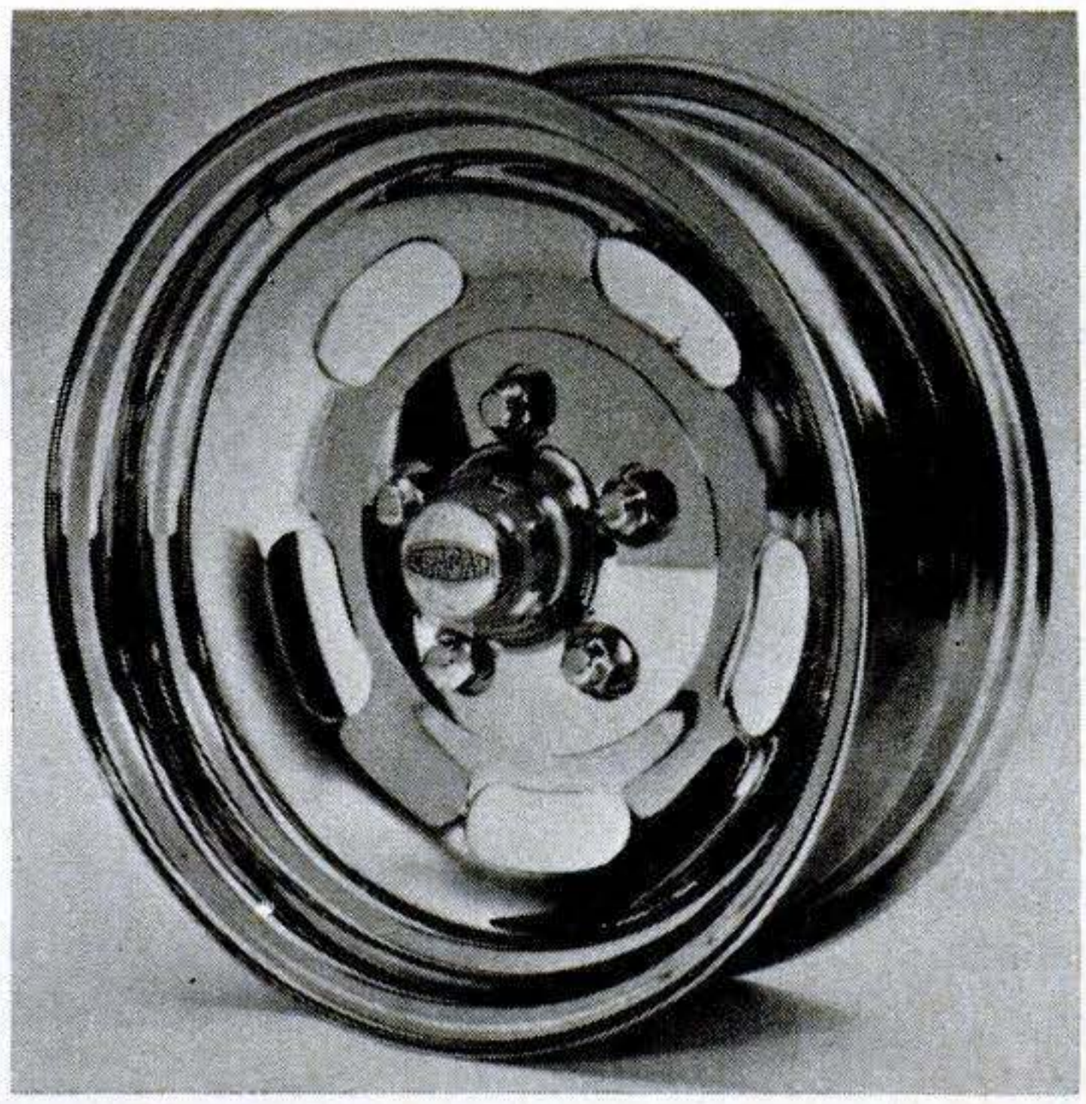
Oyltite-Stik can be used on leaking engines and transmissions, even with the engine running. It seals cracks, pinholes, gasket and flange seepages, porosity leaks, and leaks around rivets and seams. Lake Chemical Co., 250 N. Washtenaw Ave., Chicago 60612.

### Cragar slotted disk wheel

Made of heavy-duty steel, Cragar's newest wheel has wide slots for better brake cooling and stylish appearance. It's $28.50. Cragar Industries, South Gate, Calif. 90280.









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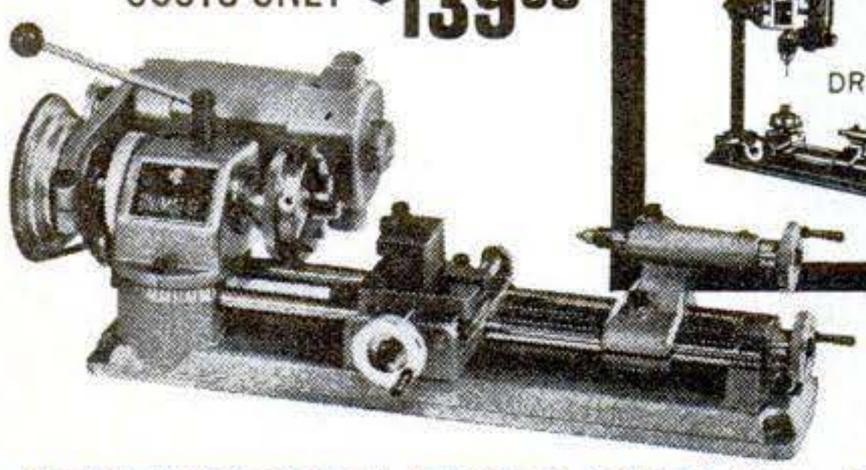


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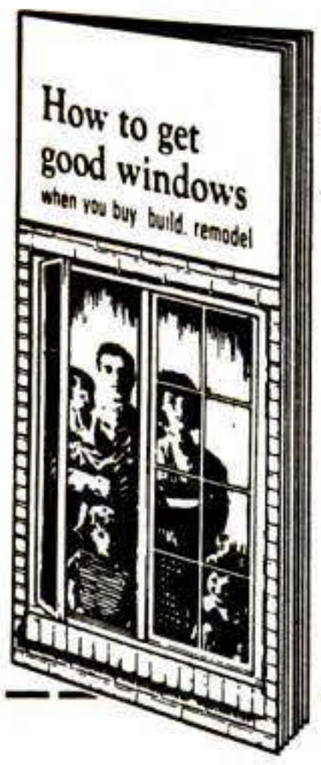


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## Home copier duplicates anything

Here's a new dry copier, the first designed for home use. The $30 copymate, made by Graphic Products, produces eight-by-10-inch copies of printed or written material, without chemicals or inks, in about a minute. You expose the original under a special copying paper which is developed over a heat platen.



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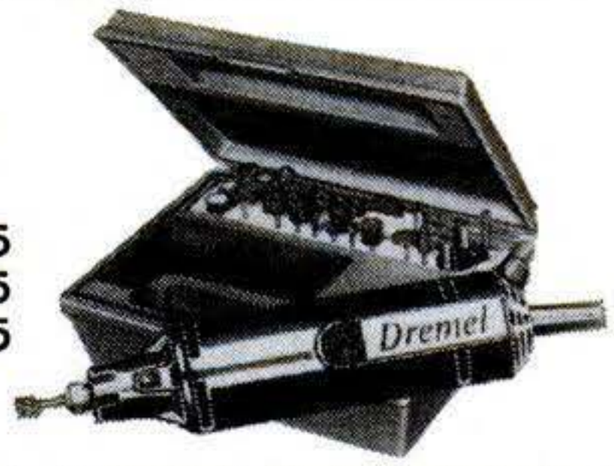


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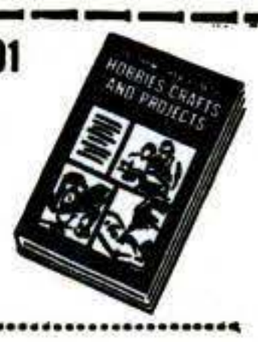


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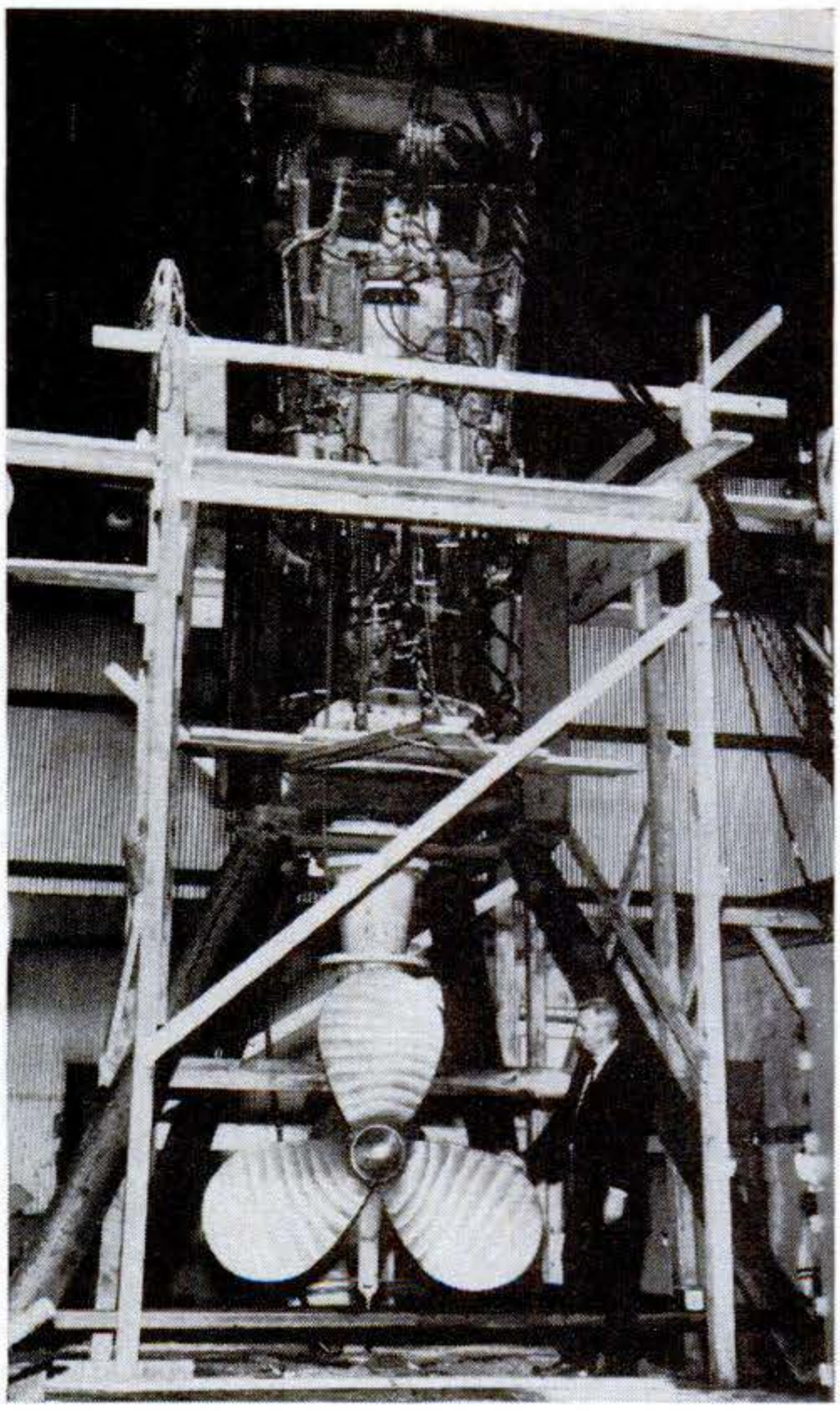
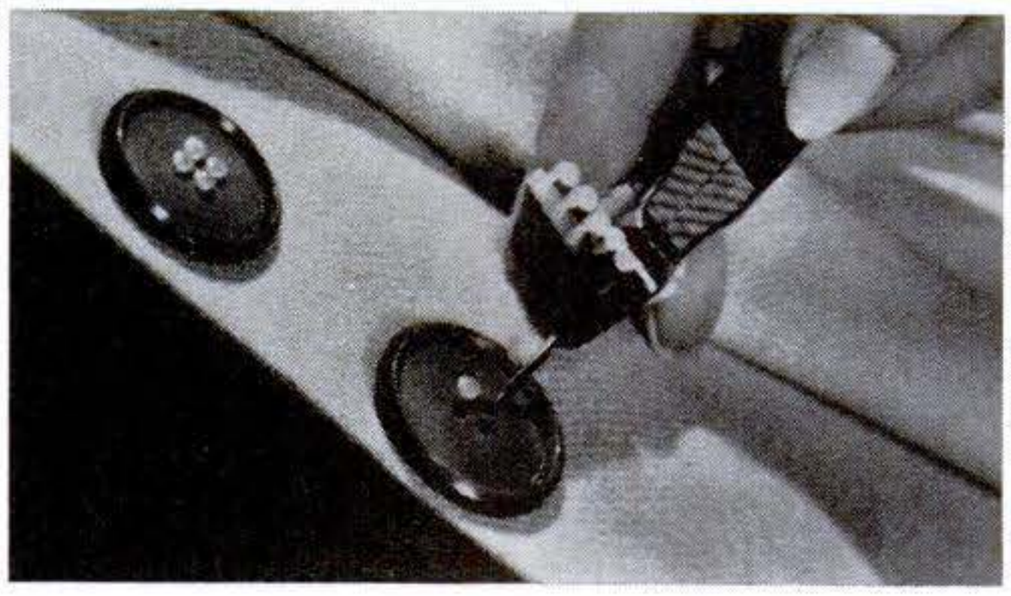


## World's biggest outboard motor

This 500-hp. GM Detroit Diesel engine was adapted by Stewart & Stevenson Services, Inc. of Houston, Tex. for use on a river barge. The 16-cylinder engine is designed for remote-control operation on the lead barge of a tow and will be used for steering and handling.



## New gadget attaches buttons

Men, you don't have to wait for the little woman to replace your buttons any more. The Buttoneer, made by Dennison Manufacturing Co., attaches them by piercing through a garment and inserting a plastic fastener that holds them on.



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# Are all your toys fair weather friends?

When the boat, the bike, the buggy, the water skis all go into hibernation – what then? Take heart! Ski-Daddler brings your kind of fun to winter. Lets you re-discover that snow is a ball. AMF Ski-Daddler Snowmobiles aren't quite like the other snowmobiles. We made them for people who needed a reliable snowmobile to help them with their winter work. Now, most people buy them for fun – but we still make them the same way. Tough. Powerful. Dependable. So put your summer toys away. Learn to love winter. Get a Ski-Daddler.

AMF makes Ski-Daddler – just for the fun of it.

For a free booklet and your dealer's name, write: AMF Western Tool Division, Box 357, Des Moines, Iowa 50302

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# Miller makes it right!

...or a few unexpected guests ...Miller makes it right!

Hearty.
Robust.
Deep-down good.
That's Miller High Life.

*The Champagne of Bottle Beer*

Miller HIGH LIFE

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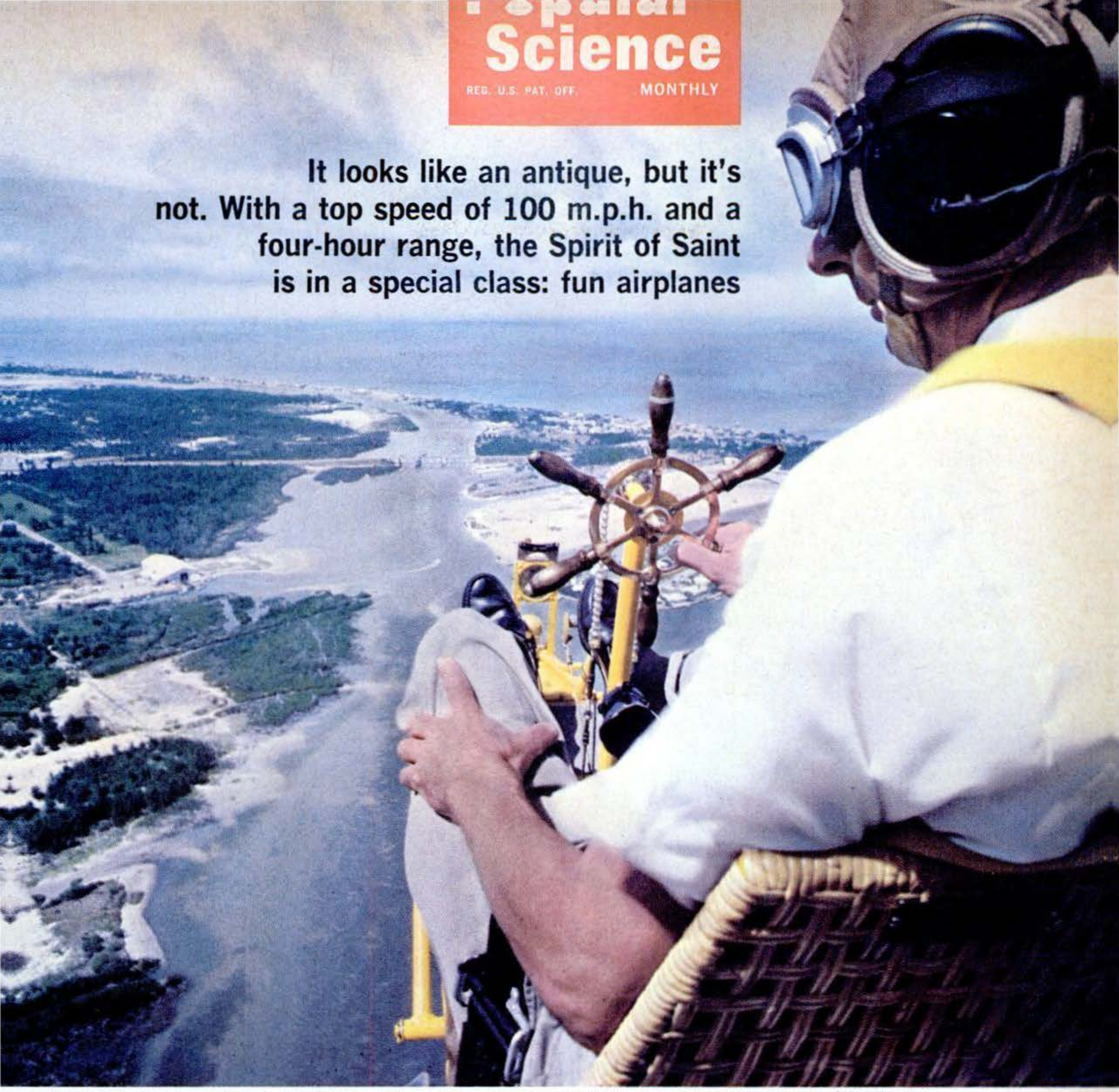
**It looks like an antique, but it's not. With a top speed of 100 m.p.h. and a four-hour range, the Spirit of Saint is in a special class: fun airplanes**



**Visibility in this ship** is limitless. "You can see so much it scares you," says a jet pilot.

# Now this is REALLY FLYING!

**PHOTO STORY BY OZZIE SWEET**

"This is the type aircraft that Orville & Wilbur Wright would have flown at Kitty Hawk Dec. 19, 1903—had they had one." So reads a plaque mounted on a strut of the Spirit of Saint, one of the most fantastic, fun-to-fly machines ever built.

You settle back in the wicker seat, belt tightly fastened, while pilot Russell St. Arnold, owner and builder of the plane,

*Continued*



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guns the little 100-hp. Continental pusher engine for a fast, 300-foot takeoff. The plane climbs rapidly at 1,500 feet per minute. The air blasts you in the face and you gasp at the view below. For nothing separates you from the elements – you're as free as a bird.

"It's a totally different, extremely pleasant feeling," says St. Arnold. "You're right out there on the front porch. The plane does what I intended – puts the fun back in flying."

St. Arnold, a dealer for Cessna and operator of a flying school at the St. Petersburg-Clearwater International Airport in Florida, admits to another objective: to interest more people in flying.

In this role, Spirit of Saint has succeeded magnificently.

At the recent International Fly-In held by the Experimental Aircraft Assn. (EAA) at Rockford, Ill., he was besieged with requests for rides. "Saint," as St. Arnold is known, flew the entire 1,000-mile trip to Rockford in his open plane. The only problems: Other pilots, spotting him in the air, had to come in close to get a good look. And flying insects are a nuisance, making goggles and helmet necessities.

"Fortunately," says Saint, "we travel slowly enough to let birds get out of the way."

**Building the plane.** The Spirit of Saint is based on a design by three Chicago charter pilots who wanted just a basic fun air-

*Continued*

**Scalloped rudder adds picturesque profile to flying**

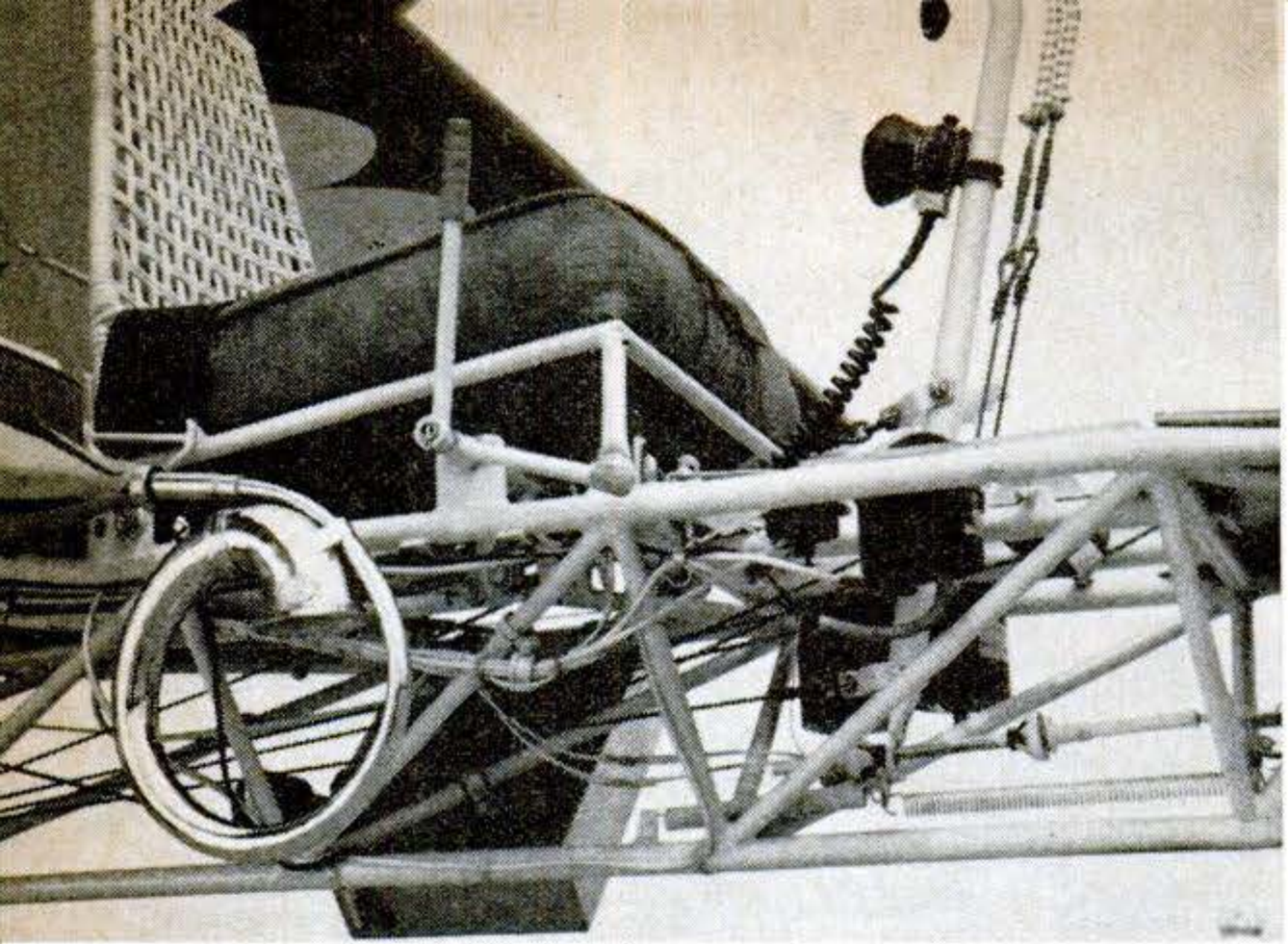
**Unlike antiques,** made of wood and fabric, this plane is built of strong chromoly steel tubing.

t flivver. It easily carries three, plus gas. And every mile of open flight is a pure joy.

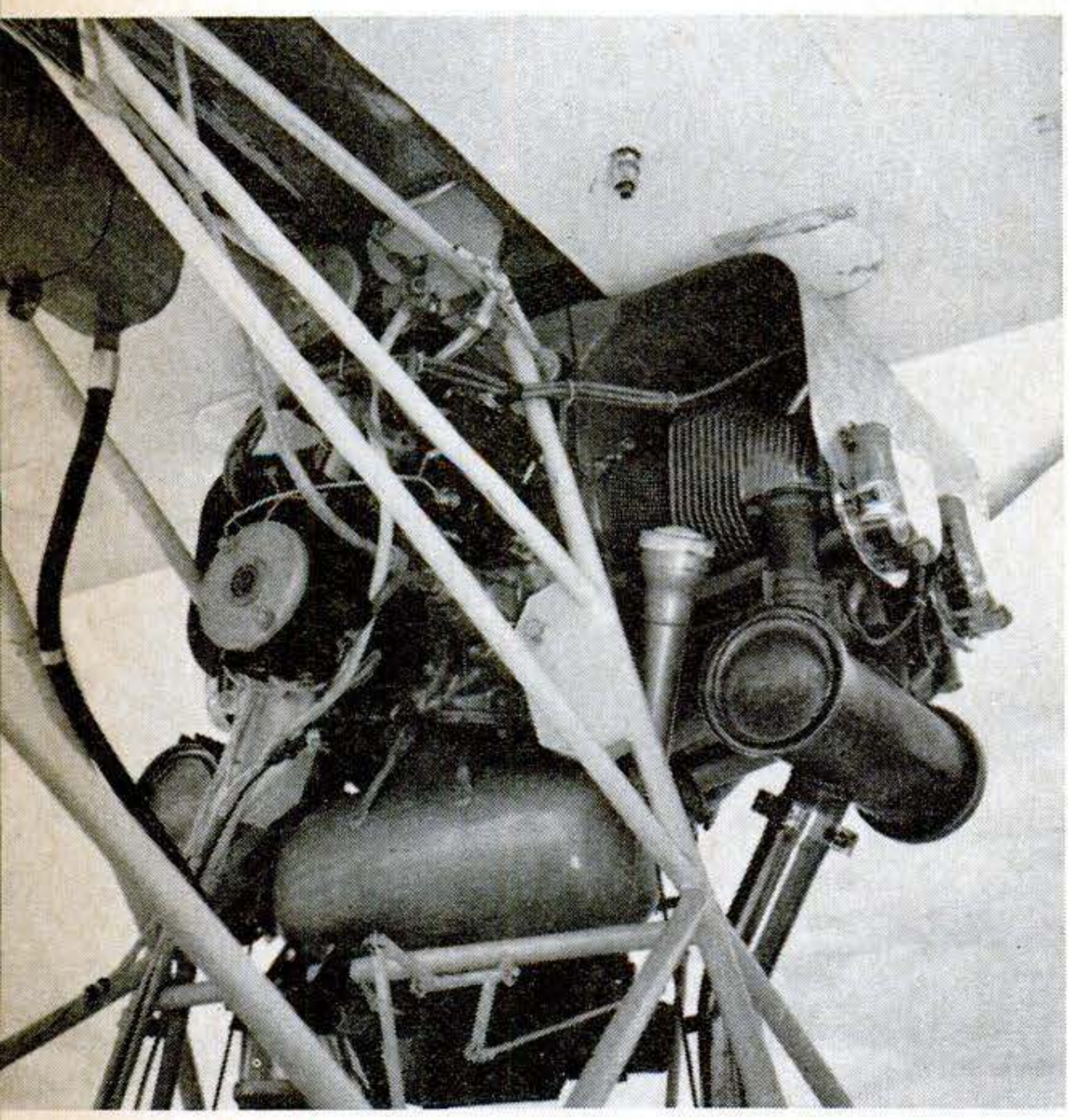
**Humorously nautical touch** is lent by discarded ship's wheel used in plane by St. Arnold (in goggles and helmet). Otherwise, control is conventional.

**Ship takes off** in steep climb (1,500 feet a minute). It needs only 300 feet of runway, can land in 100. Chromed hubs are handmade, spoked into motorcycle rims.

**A 100-hp. Continental** engine pushes the plane to 100 m.p.h. top, gives a cruise speed of 65-70. The ship has a range of four hours, or over 250 miles.



**Horn from Pakistan taxi** adds antique elegance. It contrasts with full set of instruments built into transparent panel below pilot's feet (black cylinders in photo) and mike clipped to steering column.



**Front view of engine** shows open reverse cowling (top) constructed by St. Arnold to force cooling air around cylinders. The ship has a full electrical system and starter—no prop-spinning is necessary.

**Black box at center** with see-through top opened is a deluxe 90-channel radio. Passengers sit in steel-frame wicker seats wearing seat belts tightly anchored to the frame of the airplane.

plane. Their plane, called The Breezy, was so successful that they made plans available to members of the EAA.

About a half a dozen of the Breezy-style craft have been built and at least a dozen more are in the works—all the efforts of individual members of the association.

St. Arnold took about five months working on his ship and spent $5,000. "You could build it for $3,500 easily," he says. "The cost is in direct proportion to how good a scrounger you happen to be."

Starting with a welded frame of chrome-moly steel tubing with a pyramid in the center to support the engine, St. Arnold added wing and tail assemblies from a Piper PA-12. Not satisfied with the prosaic profile that resulted, he clipped the rudder square at the top and scalloped the trailing edge to give the craft a nostalgic antique look.

The chromed wheel hubs were handmade, and fitted with spokes to motorcycle rims. These were incorporated with a Cessna spring-steel landing gear and Cessna brake assembly. Final touches: steel-frame seats wickered in a local shop, a steering wheel picked up from a shipyard, and a horn taken from a Pakistan taxicab.

The essentials of modern aviation are there, however: a full set of instruments and a 90-channel radio.

In final form, the Spirit of Saint measures 23 feet long, has a wingspan of 33 feet. Empty, it weighs 858 pounds. With 20 gallons of fuel, the plane will carry a payload of 650 pounds, but is rarely loaded to that capacity for lack of storage space.

**A "dream" in the air.** In the air she handles like a dream—"stable, very easy to fly," says St. Arnold. Top speed is about 100 m.p.h., cruise speed 70. Stall speed is 48. The plane will set down on a 100-foot runway. As with all experimental planes, the FAA followed through on every construction detail, certifying the ship's airworthiness early this year.

"This is the way flying was back in the 1920s," says St. Arnold, "and it's the way it should be. Navigation is tough with the wind in your face, so I follow the railroads and highways, one finger on a road map. It's a great feeling." PS



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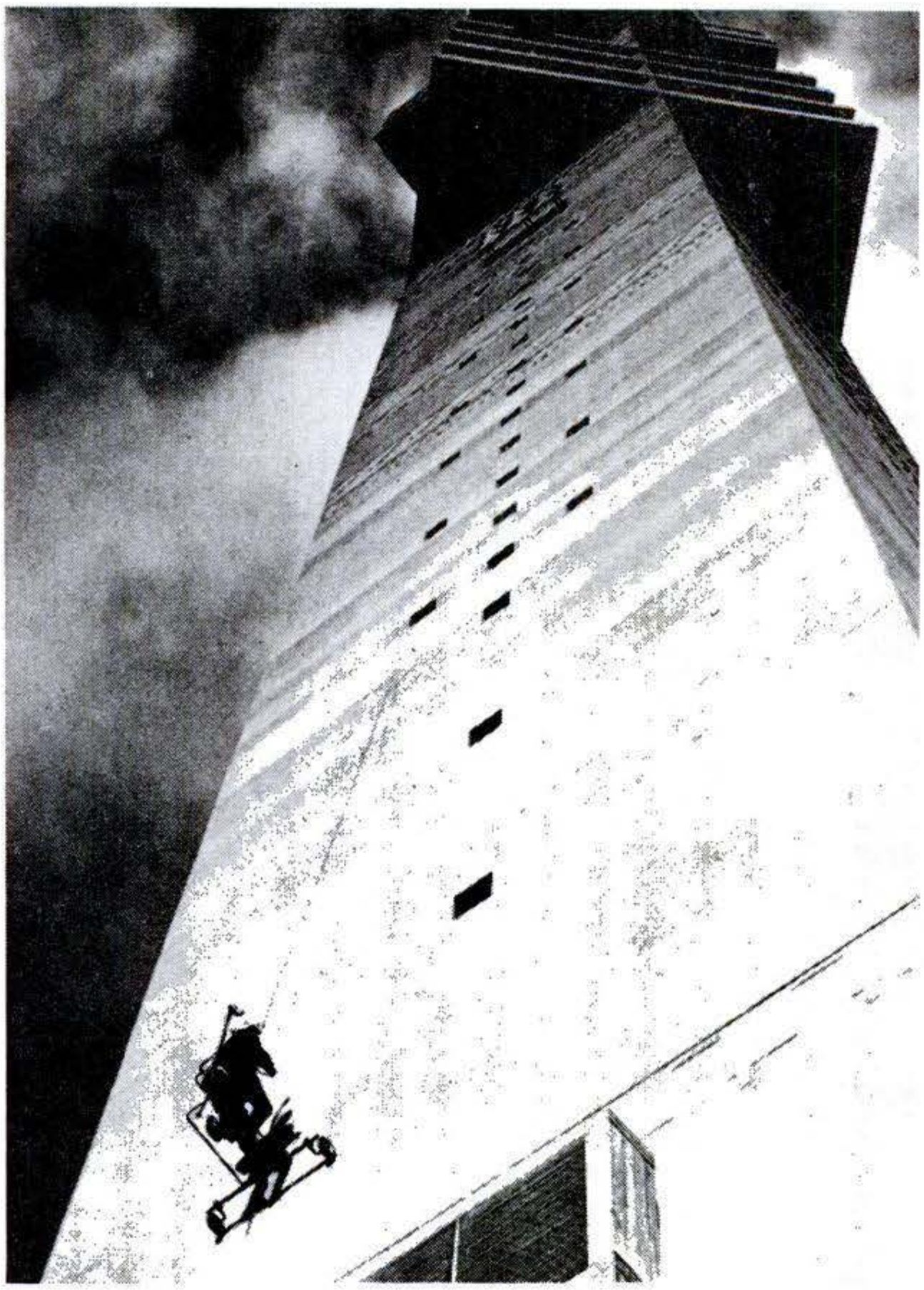
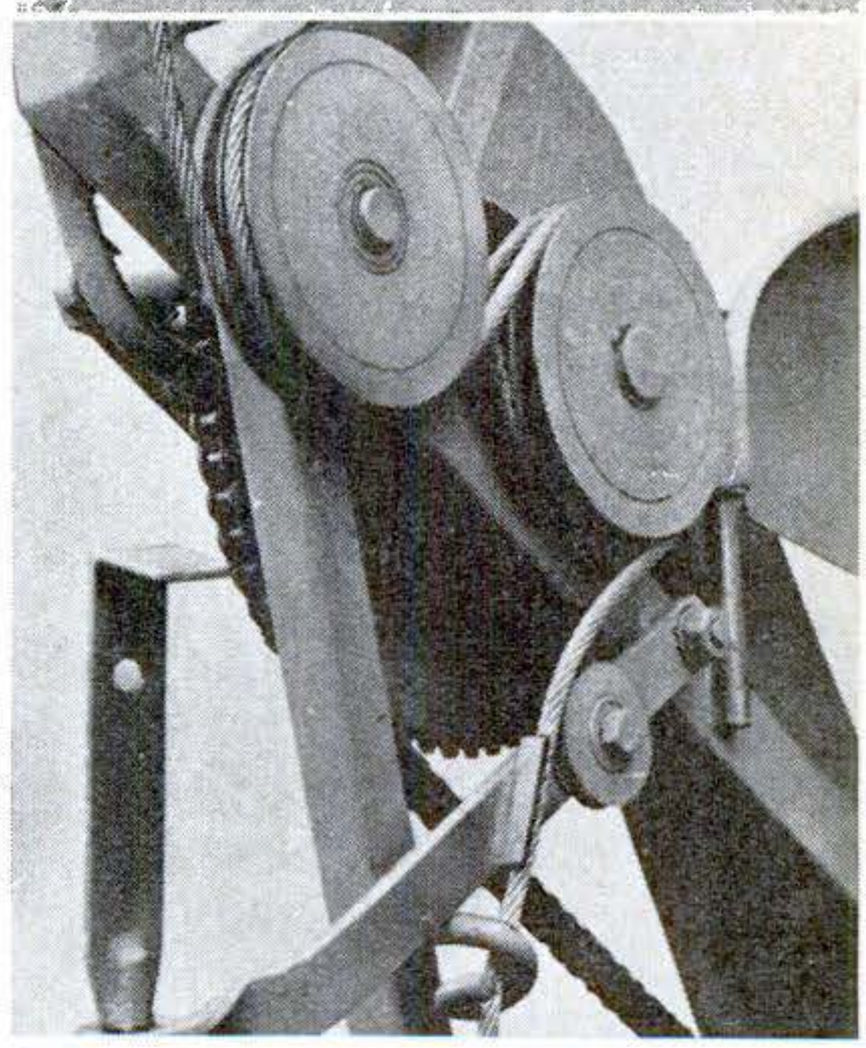
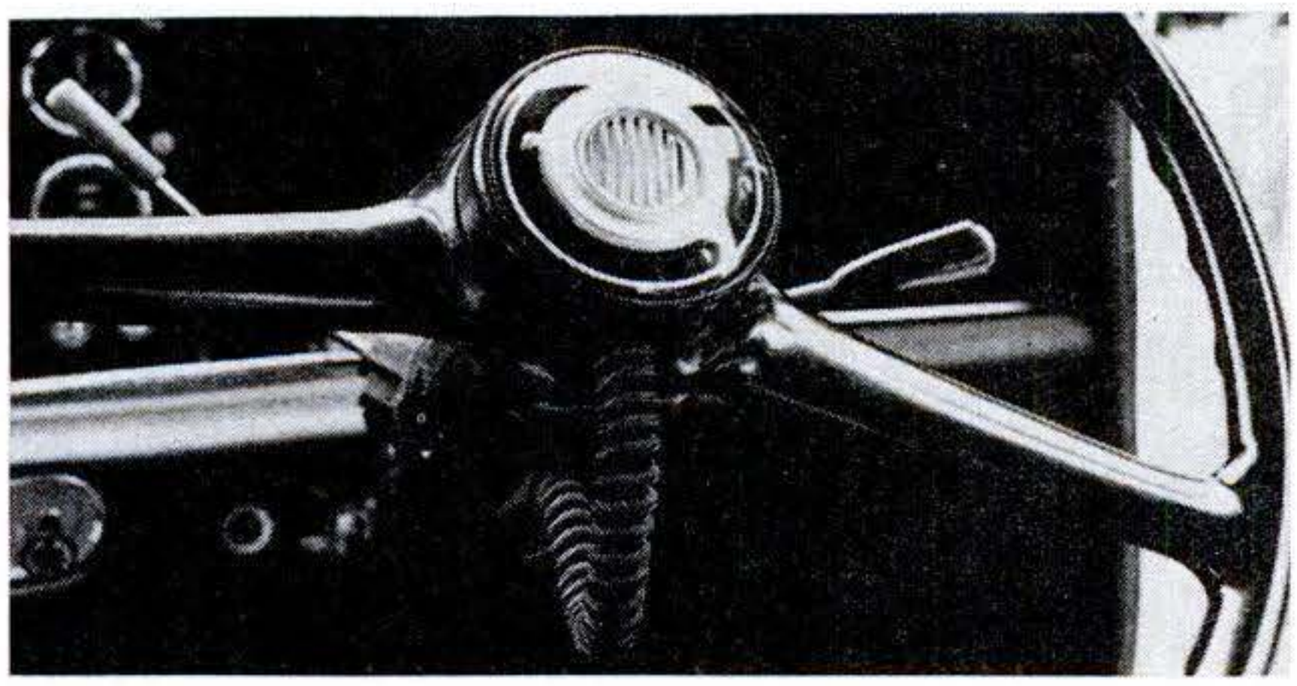




## Bike turns man into human fly

This wall-climbing bike enables a man to pedal up the side of a building for cleaning or painting. The tubular frame is supported by a quarter-inch cable wound around a pair of pulleys (right). Drive for scaling is through a sprocket on the front pulley. The sprocket includes a disk brake that operates when you back-pedal for descent. There's also a ratchet and pawl to lock the cable for stationary work. The Swedish-made bike weighs 77 pounds, can be dismantled to fit in a car trunk.

**Cable forms** double figure-eight around pulleys to keep the rig from slipping.



## Wheel hub has built-in radio

Police in Surbiton, England, just flick a lever on the right of the steering post to activate a radio mike built right into the wheel hub of their Mini-Coopers. This allows the policeman to keep both hands on the wheel while he's speaking to headquarters.



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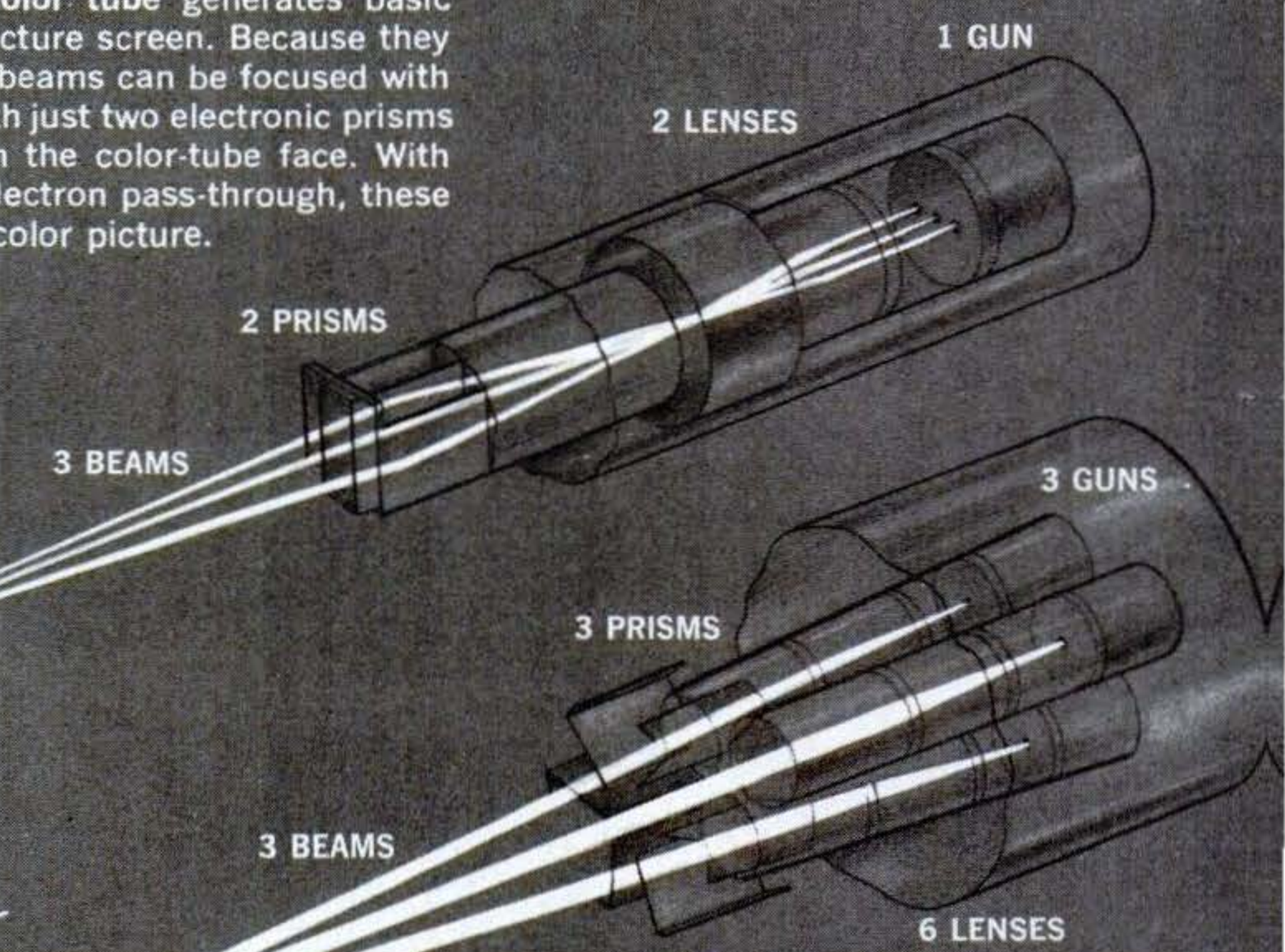
# New TV Color Tube Gives Brighter, Sharper Pictures

**New single-gun, three-electron-beam color tube** generates basic color spots—red, green, and blue—on picture screen. Because they are close together and in line, electron beams can be focused with only two electronic lenses and aimed with just two electronic prisms to excite the proper color phosphor on the color-tube face. With vertical-bar aperture grille for greater electron pass-through, these features add up to a brighter, sharper color picture.




**Old color tube,** designed around three-gun-three-beam system, uses six smaller and separate electron lenses with three electronic aiming prisms. Circular-hole pass-through in shadow-mask director plate demands more critical beam adjustment with less electron passage. Resulting TV color picture does not have sharpness or brightness of new system.

# Color TV takes a giant step forward with this new single-gun picture tube. It will give you a higher-quality, smaller-size, simpler-circuit color set—and should reduce maintenance

By **SAM SHATAVSKY** / *PS Electronics Editor*

One electron gun in this new color-TV tube does the job of the three guns used in the standard color-receiver system to emit three electron beams. Each of these beams excites and lights up the appropriate red-, green-, or blue-producing phosphor on the tube face to generate the color image.

Developed by the Sony Corporation, the new tube, called Trinitron, claims some significant advantages:

- Brighter, sharper color picture with greater contrast.
- Simplified picture-tube construction in smaller space.
- Less-complex circuits with fewer chassis components.
- Easier picture adjustment in fewer steps.
- Reduced size and weight of set.

There is no mystery to the generation of three beams from a single gun. Sony's engineers have simply combined three individual beam-producing tube cathodes into one integrated gun structure. It's like combining three single-barrel shotguns into a triple-barrel gun.

The assembly of such a unit is something else. It's critical. But apparently Sony has mastered it.

To understand how the color tube does its job, you can think of it as you would an optical system. Just as optical systems depend on lenses and prisms to focus and direct light beams, so the color-TV picture tube relies on electronic lenses and electronic prisms to steer its three electron beams to the right color phosphor on the tube's viewing face.

The three beams from one gun have been lined up much closer together than separate beams from three guns. This permits the use of two large electronic lenses instead of six smaller ones. Since large lenses intercept a greater portion of the electron beam and have a more uniform beam-focusing field, this new color-tube system yields a brighter and sharper color picture.

Besides that, the Trinitron's three beams are in an in-line, instead of triangular, arrangement. This simplifies tube-convergence adjustments—the process of directing the three color-producing beams to the same focal position at the viewing screen. In-line beams need only two adjustments compared with 12 in the old three-gun color tube. That should reduce TV service calls you have to make for convergence alignment.

Another Sony improvement is a new mask system, the Aperture Grill. The mask in a color tube is the color-selecting plate directly behind the tube's color-phosphor-coated viewing face. The new mask is a metal plate formed into vertical bars corresponding to vertical color-phosphor lines on the viewing-screen surface. (The old shadow mask uses a hole-perforated plate lined up with color-phosphor dots.) The Aperture Grill arrangement gives 30-percent more electron-beam transparency than a shadow mask, for a brighter color picture.

With these two breakthroughs, some spectacular color viewing is in store for this spring when Sony begins to ship sets equipped with the new tube.

**Single-gun color tube** (right) has smaller neck diameter with smaller wraparound sweep coil. It gives greater beam-sweep sensitivity, takes less power, and reduces the size and weight of the color set.



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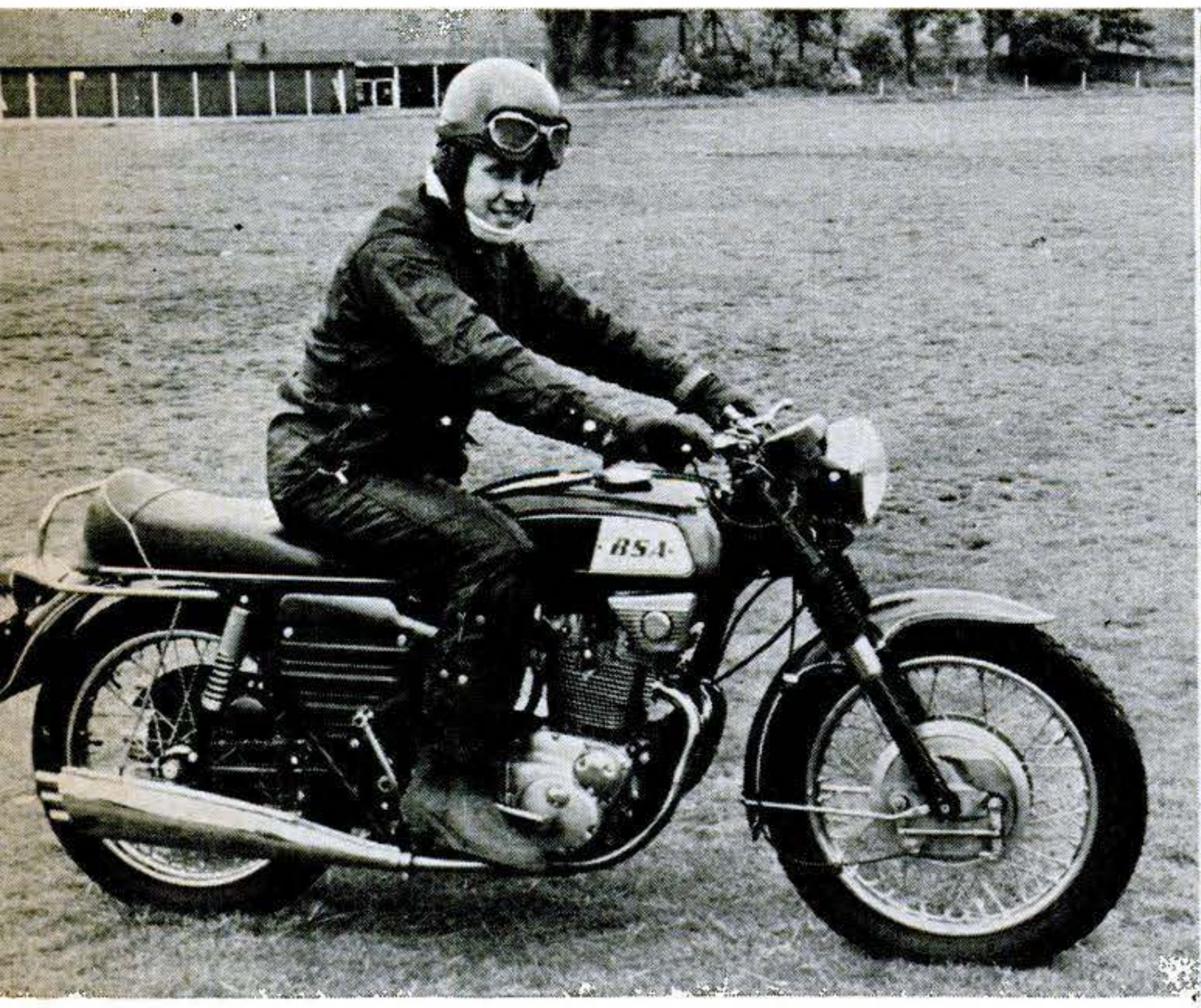
# New Three-Cylinder Engine

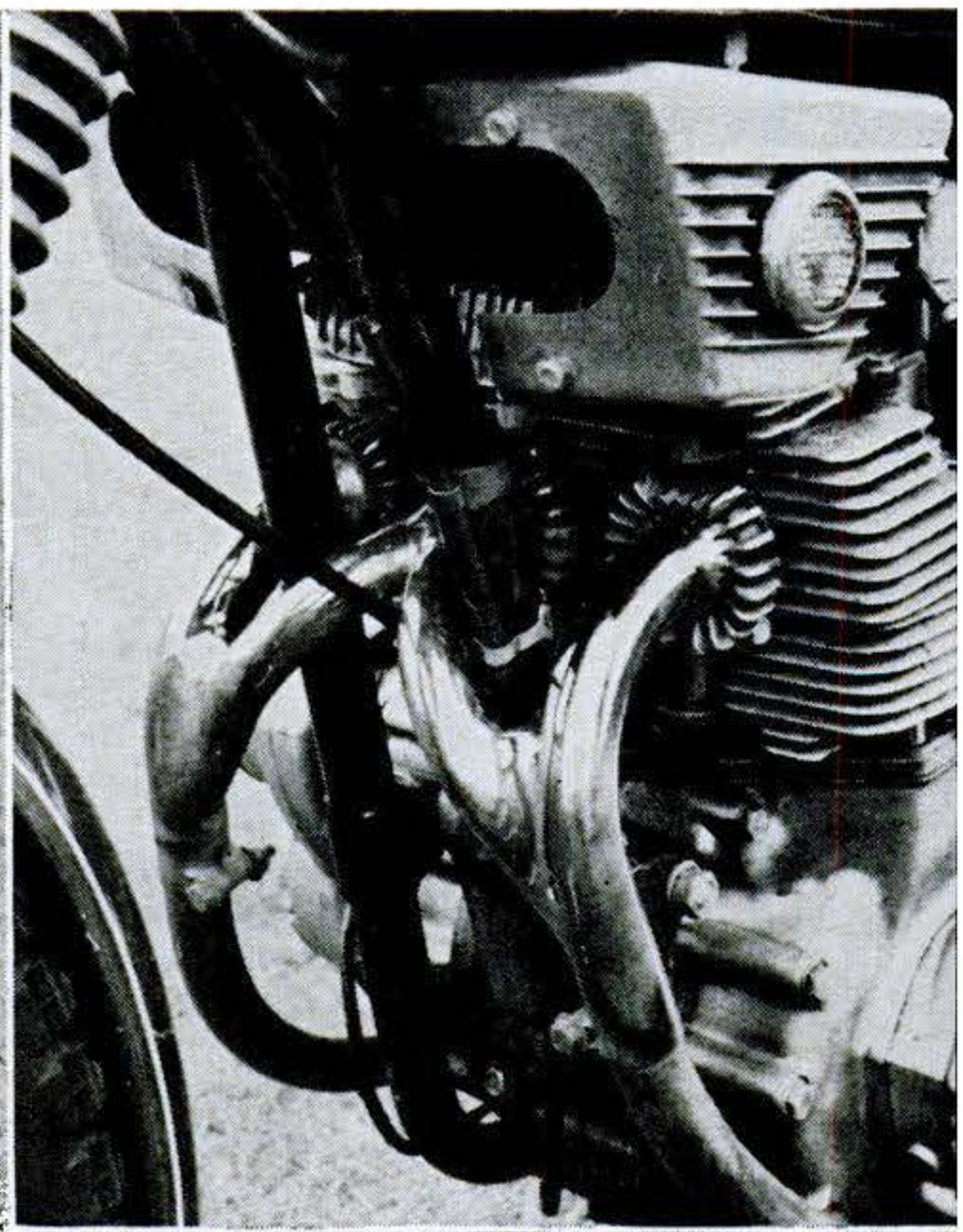
## Triumph Trident and BSA Rocket Three may put Britain back on

By JIM DAVIS

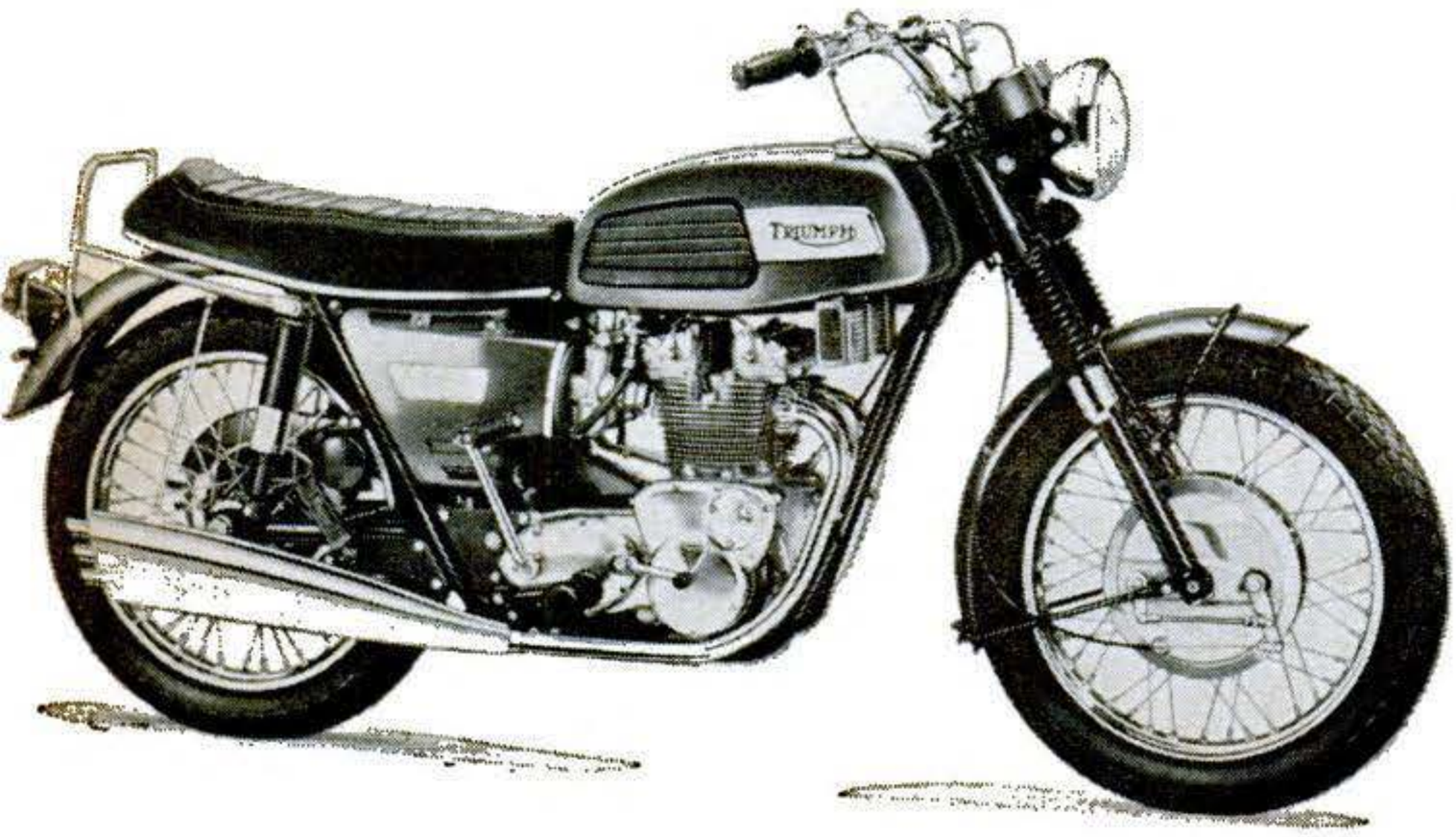
Finally, it's here—after all the rumors of the last few years that Triumph or BSA was working on a three-cylinder motorcycle—and it's in both BSA and Triumph versions. Before I tell you any more about them, other than that they're cranking out 60 horsepower from 750cc. (45.6 cu. in.), let's discuss why anyone would build a three-cylinder machine in the first place.

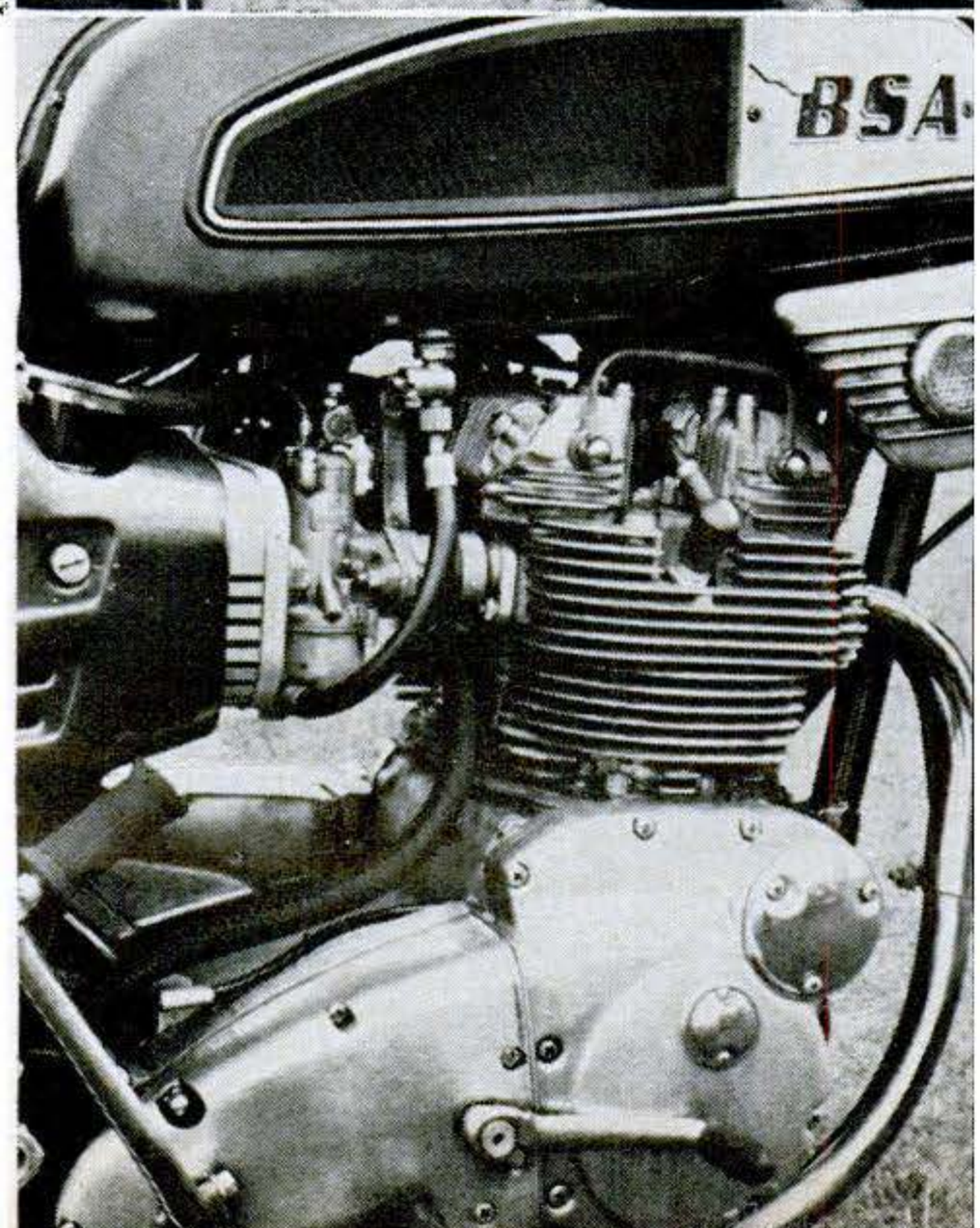
Three in-line cylinders are the least number of cylinders that can be perfectly



**Differences** between BSA (above) and Triumph (below) are easy to spot. BSA engine slants forward in double-downtube frame; Triumph engine stands upright in a single-downtube frame. Grab bar and seats differ, and gearbox casings look different (though innards are identical). Designers must have had a fit working out exhaust system. They ended up blending the pipes from the center exhaust port into the two other pipes.



# Powers British Motorcycles

## top in high-performance cycles

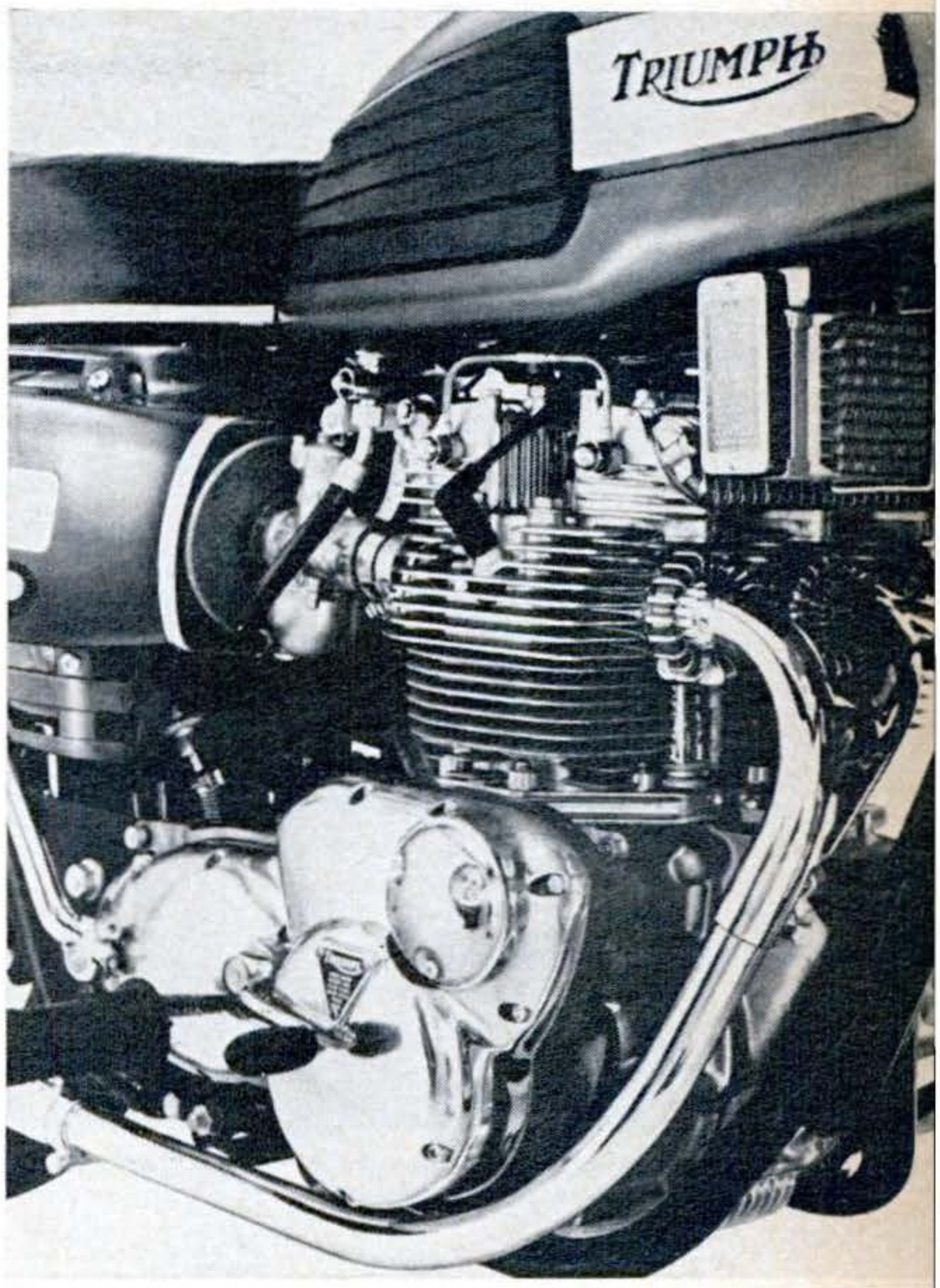
balanced, which means that these new bikes should be silky-smooth in operation. A three is cheaper to produce than a four-cylinder engine, but not much more costly than a twin. With clever design, a three can be held to almost the same width as a twin with very little weight difference. Finally, many experts contend that 650 cc. should be the maximum displacement for a twin—so a three-cylinder 750 seems an excellent solution.

Exhaust and intake duties are handled by separate camshafts operating short pushrods, which are concealed between the cylinders in tubular housings.

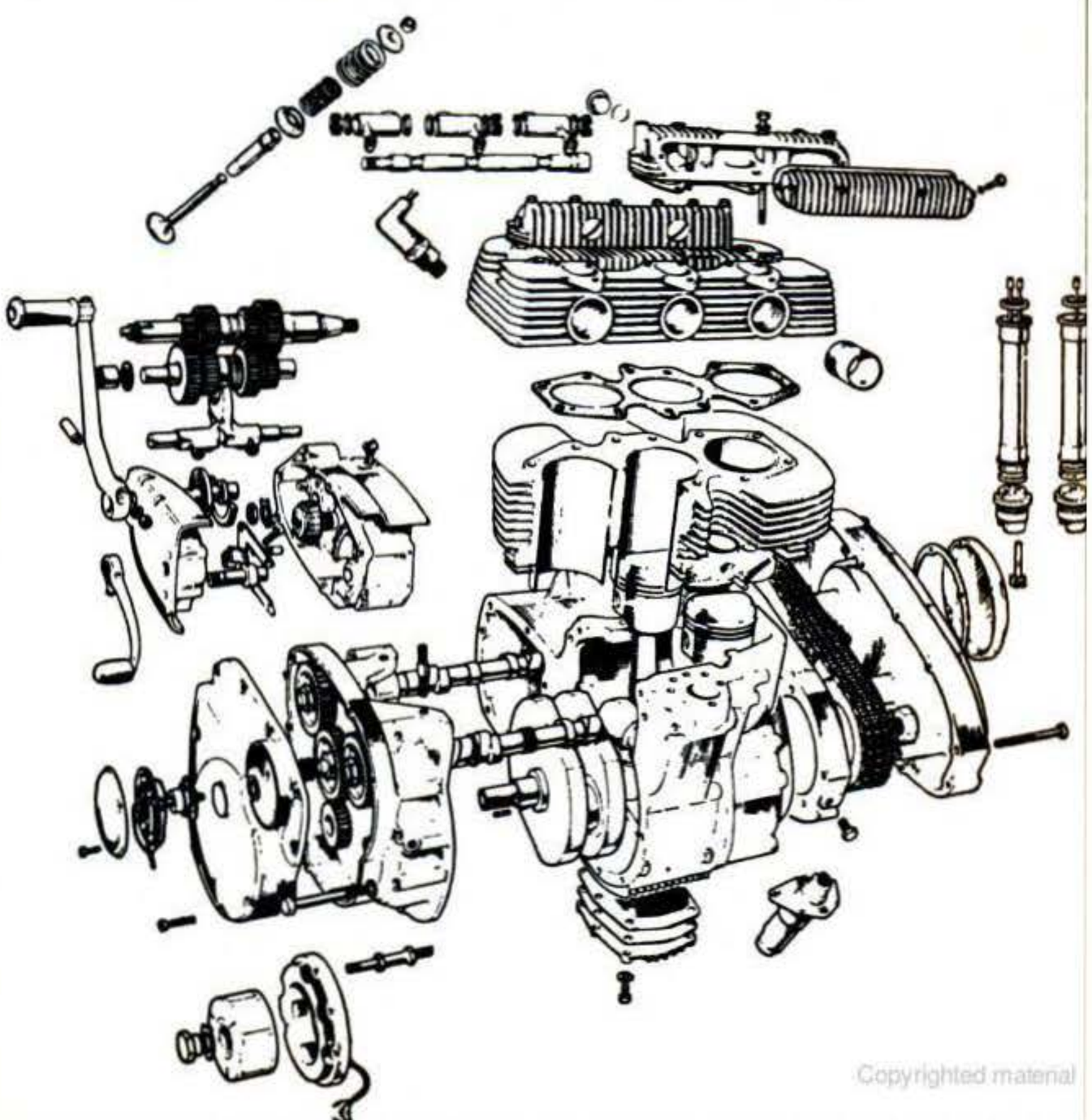
The alternator mounts on the right-hand side of the engine and runs on the crank. The end of the exhaust camshaft operates a single cam that opens and closes three sets of points. Thus each cylinder can be timed individually. Each one even has its own condenser and coil.

The gearbox is a beefed-up version of the one on the Triumph Bonneville Twin. Overall ratios are 4.89, 5.83, 8.3, and 11.95 at 657 r.p.m. in top gear, allowing a speed of 10 m.p.h. At 100 m.p.h., engine speed is 6,570 r.p.m. Maximum safe engine speed is claimed to be 8,000 r.p.m., which is getting right up there.

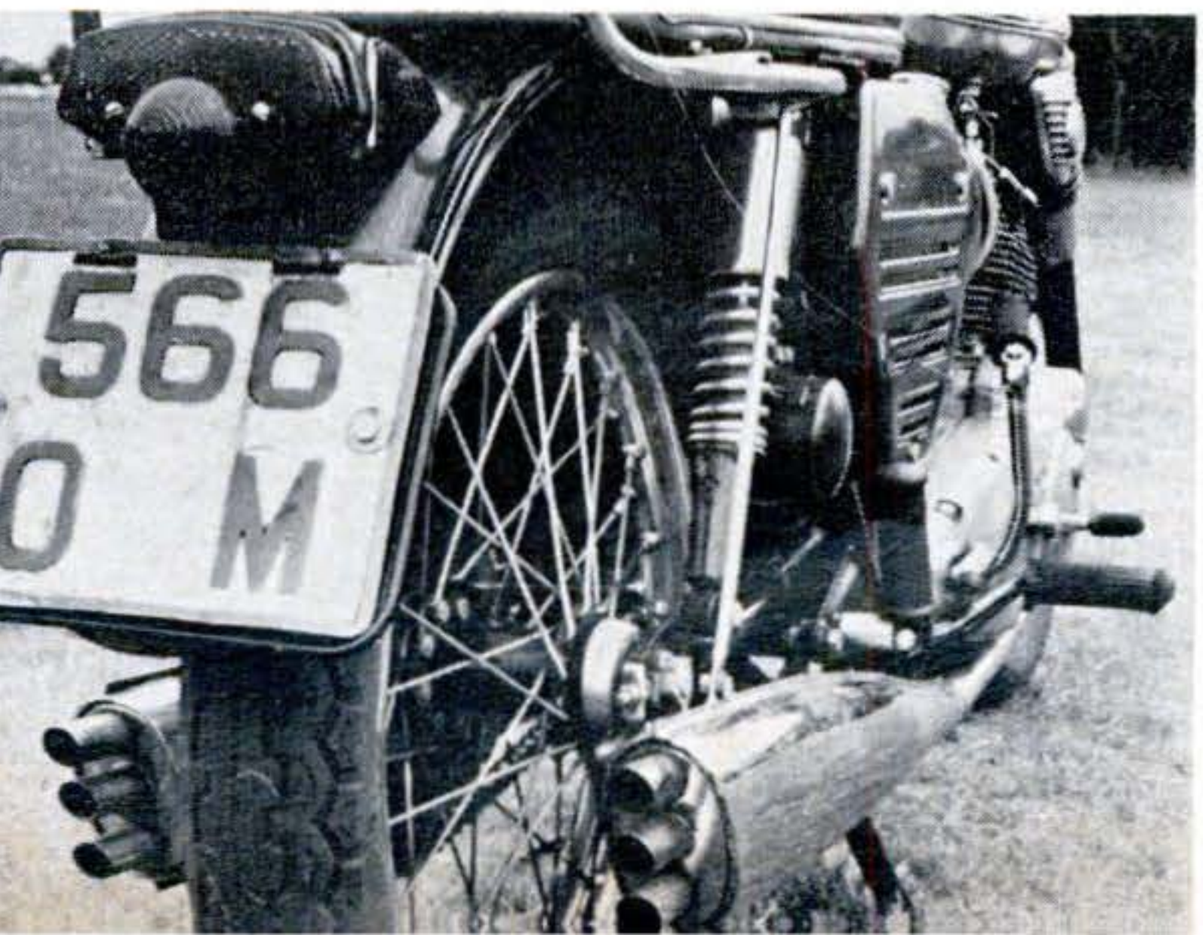
Top speed is around 130 m.p.h., and up to 90 m.p.h., these two bikes ought to be just about the fastest things around.




**The three parallel cylinders** are placed transversely in the frame. One-piece forged crankshaft has throws spaced 120 degrees and runs in four main bearings.



**Fancy mufflers** have three tailpipes. "Maybe their appearance will grow on me, but right now I'm not too sure," says Jim Davis. They may be prototype mufflers—and the design may yet be changed.

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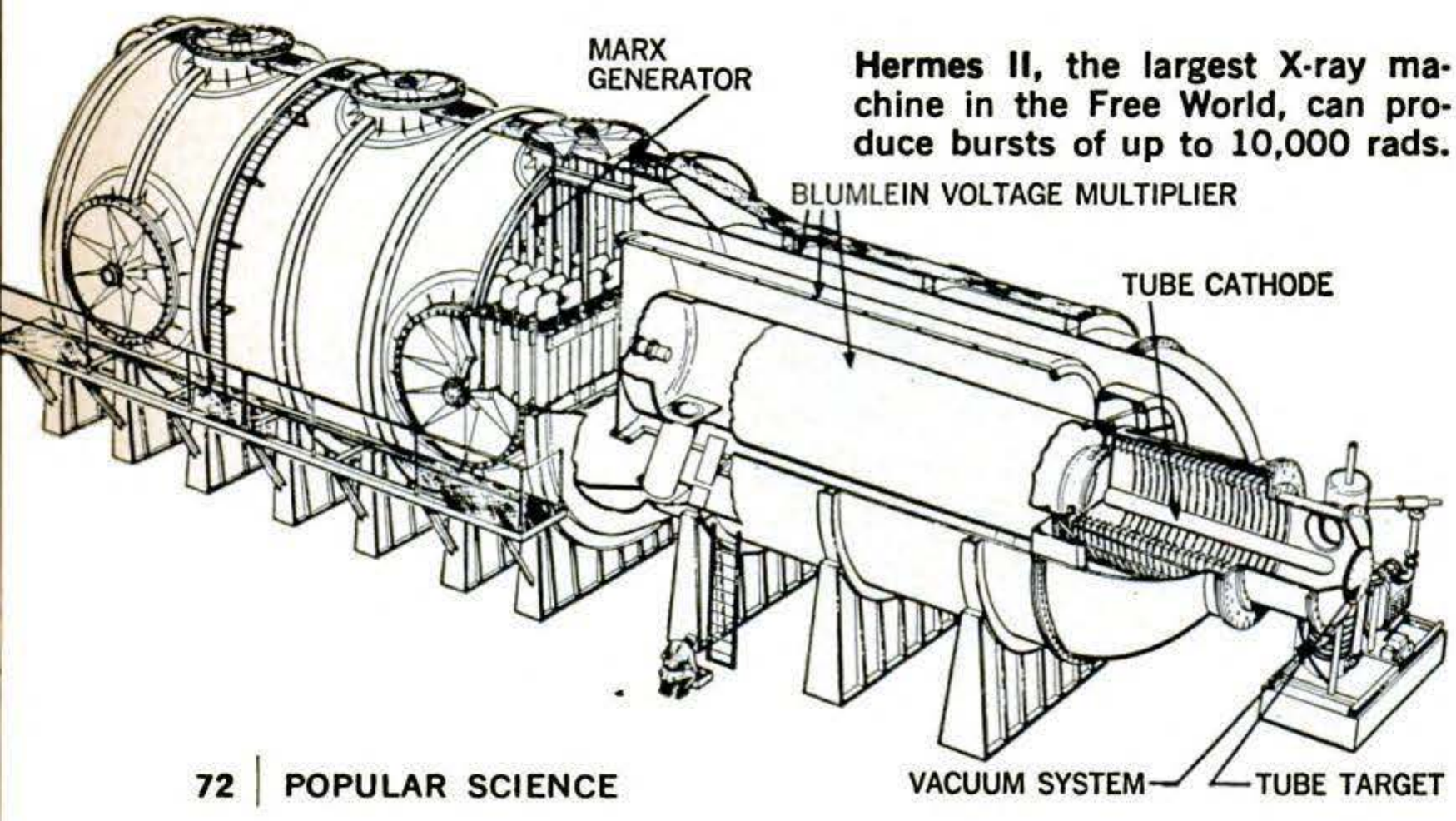
**Capacitor bank** inside huge X-ray machine's tank dwarfs workman. Tank (photo was taken during construction) is now filled with 150,000 gallons of mineral oil chosen as a good insulator at low cost.

# Our Biggest X-Ray Simulates

An X-ray machine with enough power to simulate the awesome burst of radiation from an H-bomb blast has just been completed at Sandia Laboratories, Albuquerque, N. M. A large part of the energy of a nuclear bomb goes into the production of X-radiation. When a weapon explodes, the X rays can destroy materials, electronic components, and delicate machines even though they are protected from the blast itself.




**Hermes II,** the largest X-ray machine in the Free World, can produce bursts of up to 10,000 rads.

Mission of Hermes II, as the X-ray machine is called, is to focus powerful X rays on sensitive parts and materials to see how they would stand up in a nuclear attack.

The machine is built inside a huge bottle-shaped tank, 80 feet long and 22 feet in diameter, filled with 150,000 gallons of mineral oil. Inside the wide part of the bottle are 186 large capacitors. In this section, known as a Marx generator, the capacitors are first



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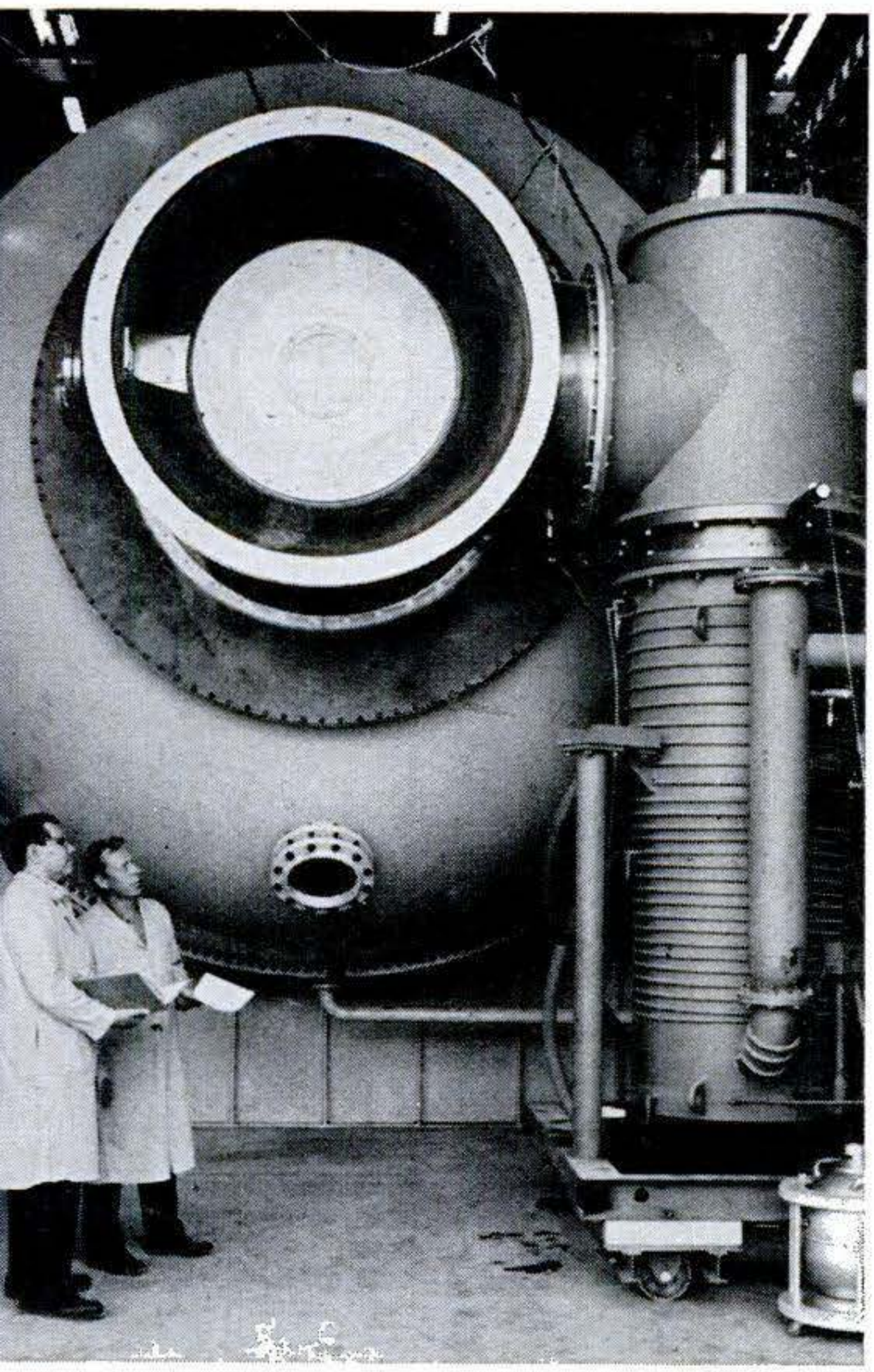


**Powerful bursts of X rays** emerge from circular tantalum placed in center of nozzle-like X-ray tube.

# H-Bomb Blast

connected in parallel and slowly charged from a DC power supply. They are then connected in series to greatly increase the voltage.

This surge of energy is fed to a Blumlein multiplier (the "neck" of the bottle), which functions as a single huge capacitor and further increases the voltage.

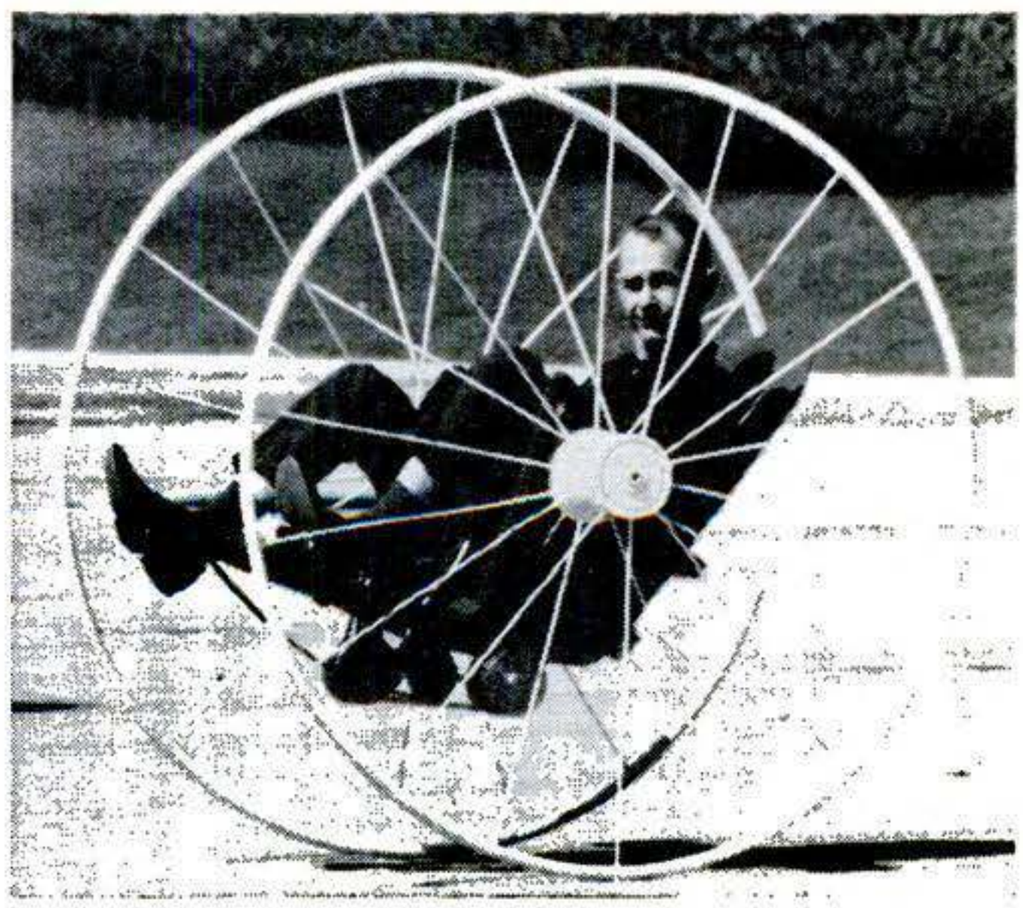
When the output of 17 million volts is applied to an X-ray tube, it accelerates electrons from the cathode against a tantalum target with enormous force. The kinetic energy of the electrons is instantaneously converted to gamma rays.

Basically, the machine is a device that can be charged with a great amount of energy slowly (35 seconds), to then release the energy very quickly in a 70 billionths-of-a-second burst of powerful X rays.

Radiation produced exceeds 10,000 rads at one meter from the target. By comparison, one dental X-ray produces half a rad.

## Speed mask streamlines swimmer

This prow-shaped mask with built-in snorkel and compass holder was invented by Calvin Gongwer and used by him in a recent 22-mile swim from Catalina Island to San Pedro, Calif. He claims that the "speed mask" cuts drag by 35 percent.



## He's a big wheeler

Albert Hawver of Tampa, Fla., goes around and around in his Orbit Cycle with five-foot wheels. He's strapped in a bucket seat slung between them. A drive wheel on the axle is chained to bike pedals. Control stick steers and brakes.



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## Will bikes, buggies, or four-wheel drive win

# Mexican Off-Road Race?

Last year's winners, Vic Wilson and Ted Mangels, blazed a dusty trail from Tijuana to La Paz with their factory-backed Meyers Manx.

### Today's tough guys race off the road in some of the most unlikely cars this side of Chitty-Chitty-Bang-Bang

BY JAMES W. WRIGHT
*PS West Coast Editor*

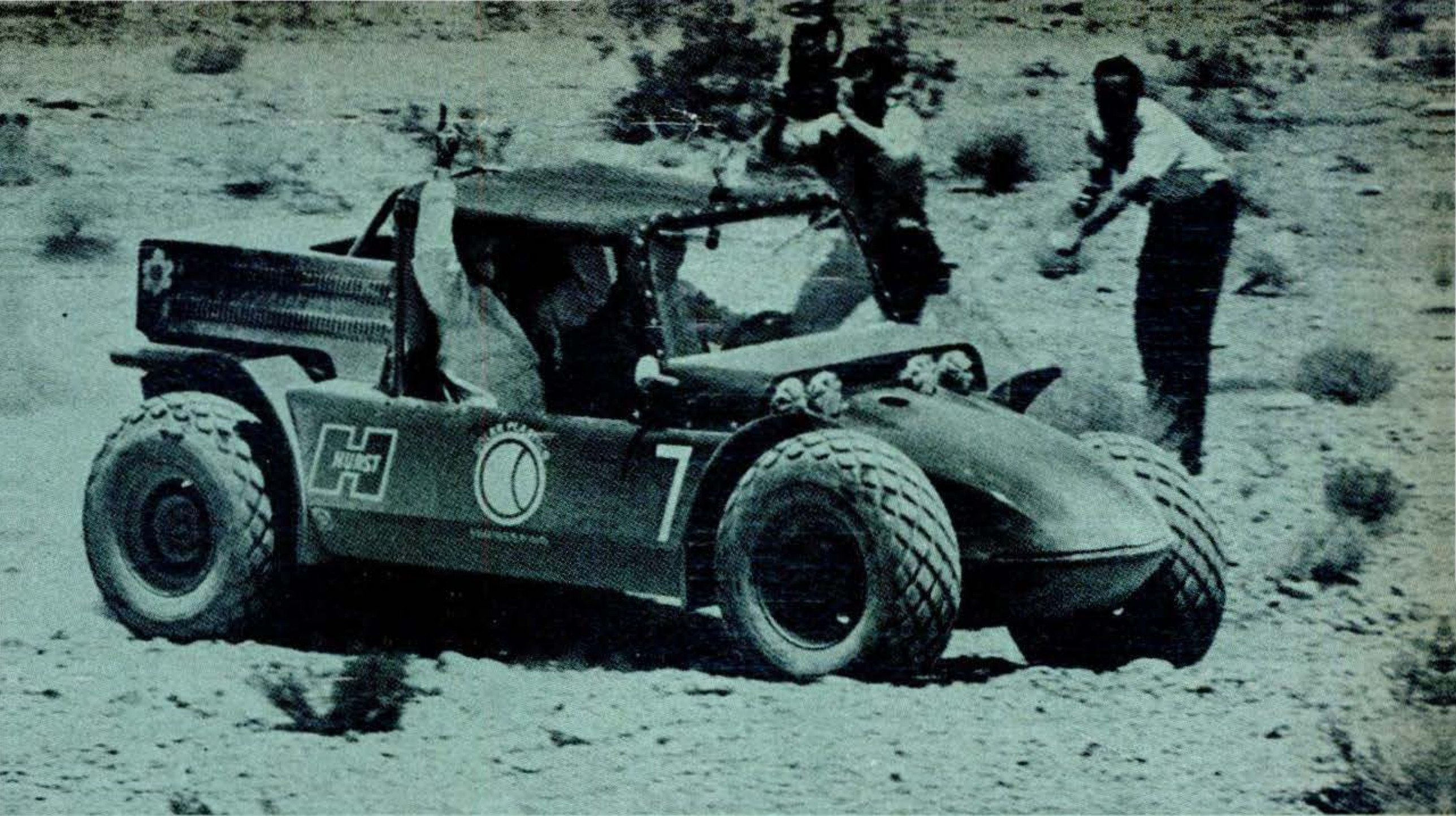
Class-winning Bronco, driven by Larry Minor and Jack Bayer, was also first four-wheeled vehicle to cross the finish line in the 7-11.

The biggest off-road race to date will be held Nov. 4-7 between Tijuana and La Paz in Baja California. More than 200 entries are expected, and prize money will be over $30,000.

The Baja peninsula has always held a kind of mystic charm for Western off-road enthusiasts. The "road" that traverses it is one of the worst imaginable, and in most off-road circles you haven't arrived until you've been over it. Or at least tried to get over it.

Approximately 920 miles long, the road offers just about every off-road obstacle you can think of. In some places the dust is as fine as talcum and its depth is measured in feet. Sometimes the road takes off down dry riverbeds or across sandy tide lands. Where the road is prone to washouts, the trucks that regularly drive it have dug ruts large enough to lose a car.

What kind of cars are used for this grueling event? There's an even mix-




**Steve McQueen and Bud Ekins** drove this Baja Boot in the Stardust 7-11 at Las Vegas and completed one lap of the completely off-road course. Chevy-powered, Boot has four-wheel drive with Toronado parts.

**sarry Bergquist's Honda** won :-11 in 22 hours, 17 minutes.

**Optimistic drivers** in stock Corvair (tires, suspension, everything) didn't get very far in last year's Mexican event. You need an off-road car.

ture of four-wheel drive vehicles and dune buggies, plus motorcycles and modified passenger cars. The National Off Road Racing Assn. (NORRA) breaks down the entries into eight classes:

- Class I. Production two-wheel-drive passenger vehicles (sedans, station wagons, Jeep Wagoneers, etc.).
- Class II. Production two-wheel-drive utility vehicles (Jeeps, pickup trucks, etc.).
- Class III. Production two-wheel-drive buggies (series-produced, home-built buggies with stock VW, Porsche, or Corvair power plants).

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- Class IV. Modified or nonproduction two-wheel-drive vehicles (one-off's, or Class III buggies with modified engines).
- Class V. Production four-wheel-drive vehicles (Jeeps, Toyotas, Broncos).
- Class VI. Modified or nonproduction four-wheel-drive vehicles (homebuilts, Jeeps with Chevy engines, the Baja Boots).
- Class VII. Motorcycles up to 250cc.
- Class VIII. Motorcycles over 250cc.

NORRA held its first race a year ago, in Baja California. It drew 68 intrepid starters. On hand was everything from a 1956 Chevrolet sedan to the $50,000 specially built Baja Boot. Prior to the start the smart money was riding on the motorcycles.

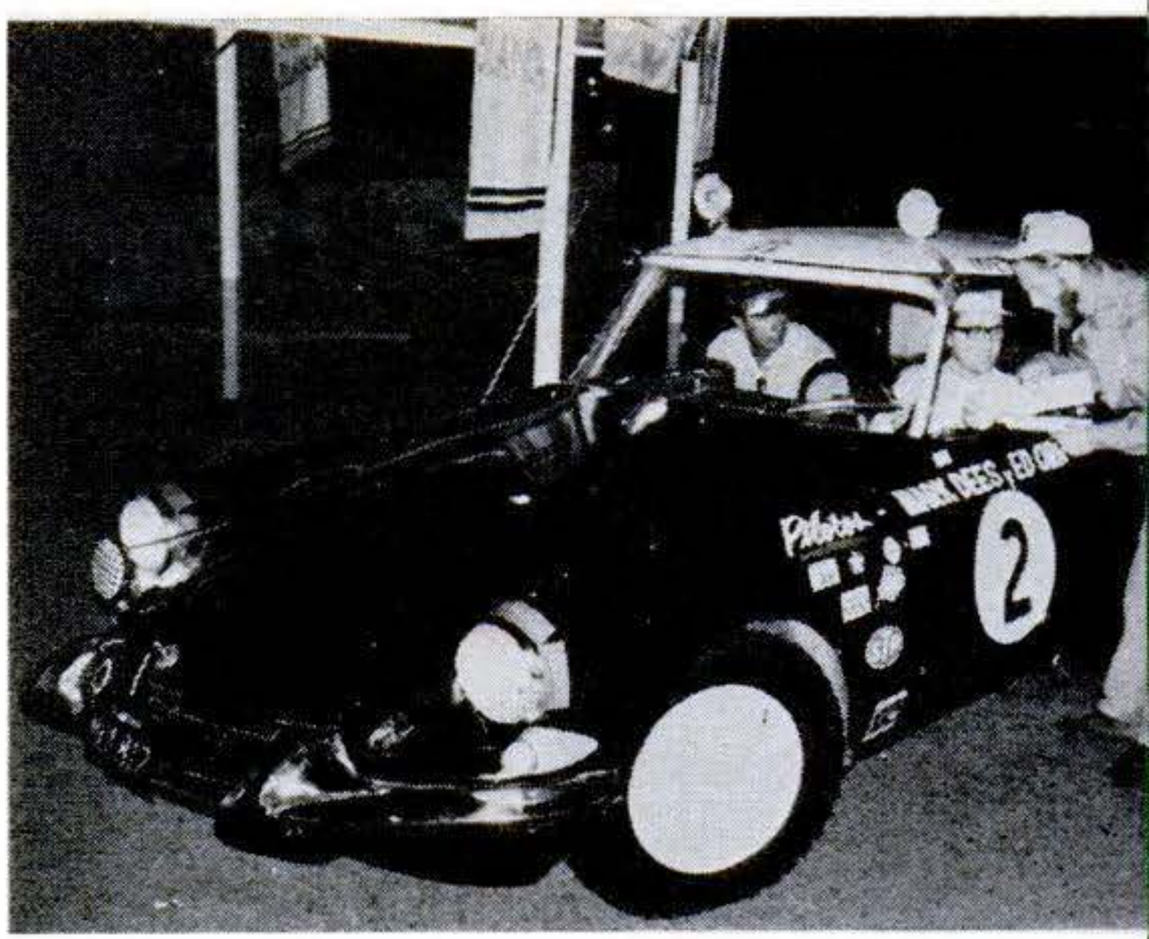
Halfway through the race they still looked like a good bet. One bike was about four hours ahead of the closest four-wheeler. But then darkness fell and somehow the bike rider got lost. This was all that the hard-driving team of Vic Wilson and Ted Mangels needed with their factory-backed Meyers Manx. Their winning time of 27 hours, 38 minutes was a new record, besting the old one by two hours, 22 minutes.

A total of 31 starters finished before the 60-hour time limit ran out. They split a $13,775 purse.

**A desert race.** Early in June of this year NORRA teamed up with the Stardust Hotel in Las Vegas to put on the Stardust 7-11. This was to be a desert race of two 355-mile laps.

Unlike the Mexican race, this one didn't follow an existing road. For the most part it just went right across the desert. Tough? More than 75 percent of the cars never completed the first lap.

Indicative of the wide interest in off-road racing were the entries of screen actors James Garner and Steve McQueen. Both are long-time race enthusiasts, McQueen also being a one-time desert motorcycle racer. Garner teamed up with sports-car ace Scooter Patrick to drive a Porsche-powered Manx, while McQueen co-drove a Baja Boot with ex-motorcycle star Bud Ekins. Garner and Patrick made it about halfway through lap one before they encountered a large rock. McQueen and Ekins made it through the first lap.




**Stock Citroën carried** Mark Dees and Ed Orr in '67 race, but its drive shaft broke before halfway mark.

It was apparent at the 7-11 that more and more vehicles are now built strictly for competition. I was a co-driver on one such vehicle. It was superlight, yet had a superstrong frame of chrome-moly tubing.

Pushed by a Revmaster 95-hp. VW engine, it worked real well regardless of terrain—but unfortunately the battery wasn't superstrong and its innards shook themselves loose after we had run about 250 miles of the first lap.

**The cyclists' revenge.** The cyclists got back for the drubbing they took in Mexico by completely wiping out their four-wheeled opposition. The winning bike took a scant 22 hours, five minutes to complete the course. A Honda, ridden by Larry Bergquist and Gary Preston, it was followed by three more bikes.

The first four-wheeler across was a Holman-Moody-Stroppe-prepared Ford Bronco driven by Larry Minor and Jack Bayer. Their time was 27 hours, 17 minutes, over five hours behind the winning bike. They were, however, almost three hours faster than the first buggy across the line.

In addition to offering some mighty interesting equipment, this year's Mexican 1000 is beginning to look like the *Who's Who of Racing*.

Dean Jeffries, builder of the Kyote, has filed entries for three-time Indianapolis winner A. J. Foyt and long-time Indy car driver Roger McCluskey.



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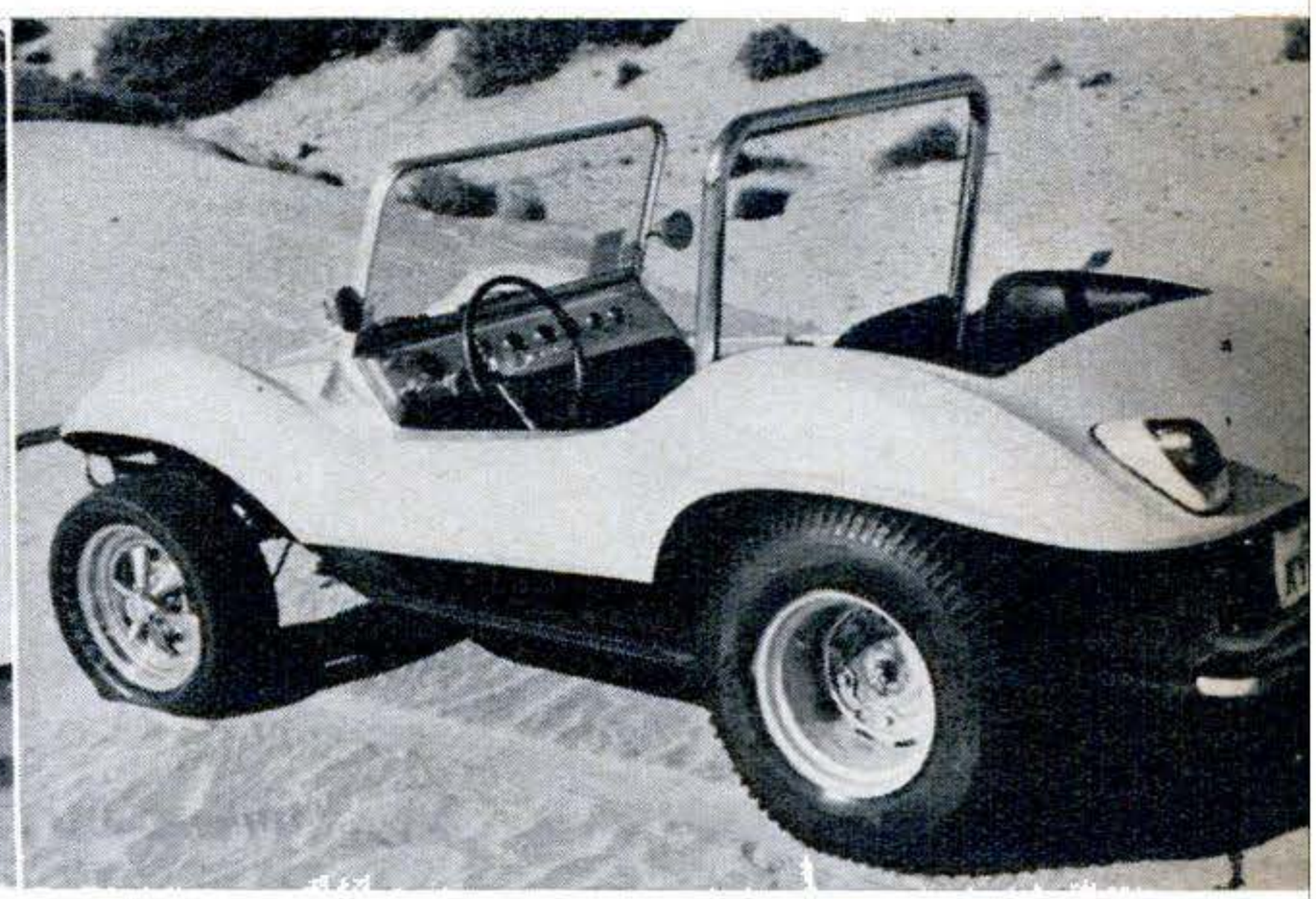
## at Indy, but its popularity keeps right on growing

**Bugetta,** built by Jerry Eisert (of Indy fame) is Corvair-powered, with very low center of gravity.



**Kyote,** built by Dean Jeffries, sets new, crisp style in buggies. A. J. Foyt will drive one this year.

Also on hand will be the Unser brothers, Bobby and Al. Bobby has won the Pikes Peak Hill climb nine times. He won this year's Indy 500 and is currently the USAC points leader. Brother Al is currently the hottest thing on the USAC Championship trail and is rapidly overtaking brother Bob in the points race. They have been entered by the Hayden Transcooler Team and will be driving either a Revmaster Spider or one of the new Meyers Tow'ds.

It is almost a sure bet that with Foyt entered, Parnelli Jones will get in. If so, he will be driving a Stroppe-prepared Ford Bronco.

Rumored possibles include the names of sports-car and Trans-Am sedan champs, Mark Donohue and Jerry Titus.

On the celebrity side we have James Garner, Steve McQueen, Mike Nesmith (of the Monkees), and John Wayne.

Garner will again team with Scooter Patrick, but this time they will be driving a Stroppe-prepared, but privately entered, Ford Bronco.

McQueen hasn't committed himself about his vehicle.

Nesmith will co-drive a Kyote with designer-builder Dean Jeffries.

John Wayne will confine his Mexican 1000 participation to sponsoring a buggy driven by two of his friends, Everett Creach and Clyde Howdy. Both are veteran motorcycle racers and long-time motion-picture stunt men.

Off-road car builders are getting to the point where they're almost as secretive as their Indianapolis counterparts.

Bruce Meyers, of Manx fame, is readying a team of three of his new Tow'ds. Usually VW-powered, there's a strong possibility that these will hit the starting line sporting German-built Ford V-4s.

GM engineer Vic Hickey, designer and builder of the Baja Boots, will again enter them.

Indy-car builder Jerry Eisert has entered one of his newly designed and marketed Bugettas. This car looks like a Group 7 sports-racing car and is powered by a Corvair engine. Bob Thomas of the Los Angeles *Times* will drive.

American Motors has been interested in Baja for quite a while. At one time the absolute record—30 hours flat—was held by an AMC Rebel. They will supply factory support to the team of Ralph Poole and Spencer Murray and their Rambler entry.

The factory-backed Holman-Moody-Stroppe Ford Bronco team is something to see. In addition to the usual immaculately prepared Broncos, the Stroppe team is backed up by one or two airplanes, a helicopter, and several machine-shops-on-wheels.

The Revmaster Engine Co. is entering four of their Spiders. Several cyclists have test-driven the Spider and pronounced it the closest thing to a two-wheeler they've ever driven. PS



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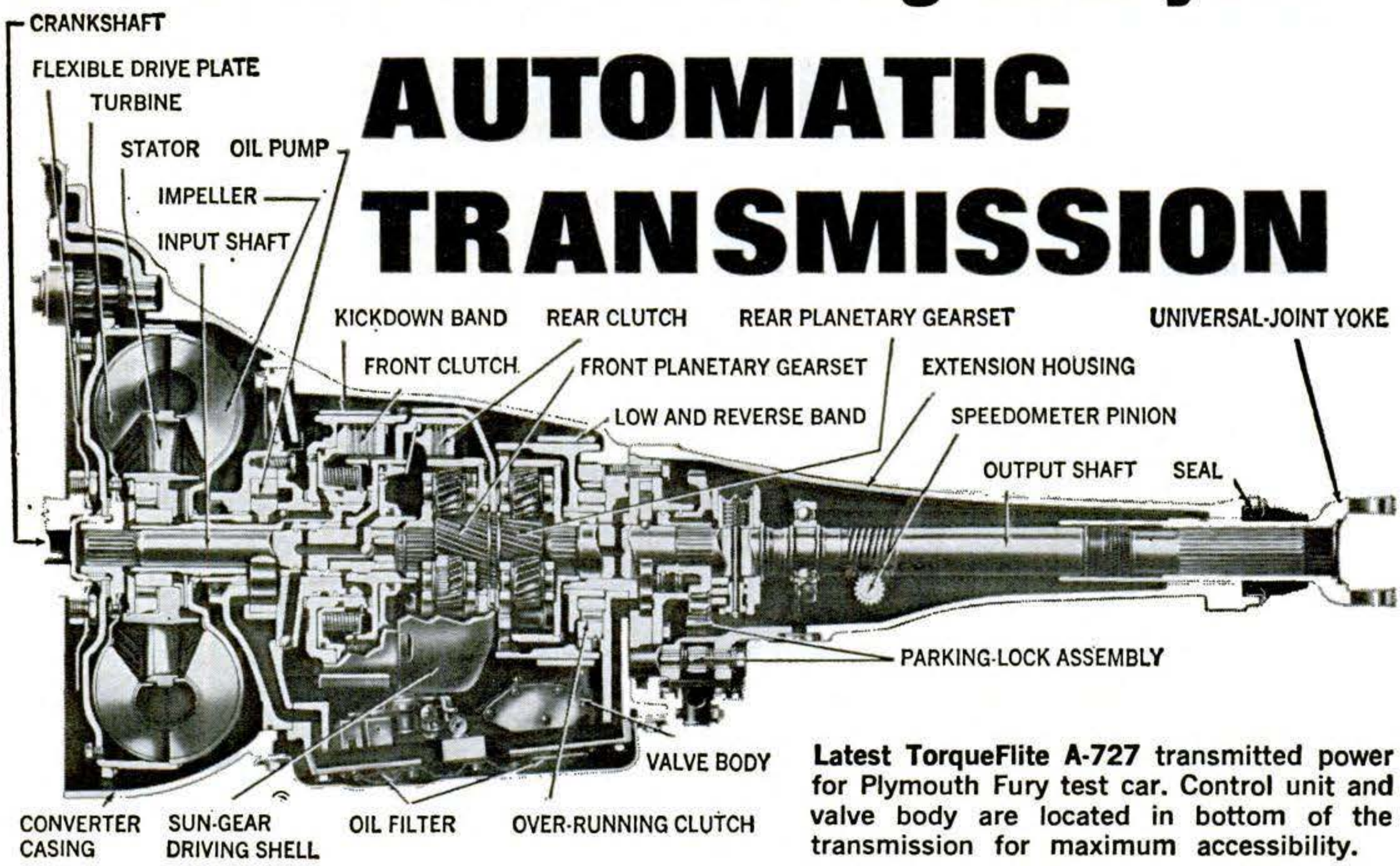
**Little box with big name**—automatic transmission malfunction simulator—is demonstrated.

# How to tell what's wrong with your AUTOMATIC TRANSMISSION




**Latest TorqueFlite A-727** transmitted power for Plymouth Fury test car. Control unit and valve body are located in bottom of the transmission for maximum accessibility.



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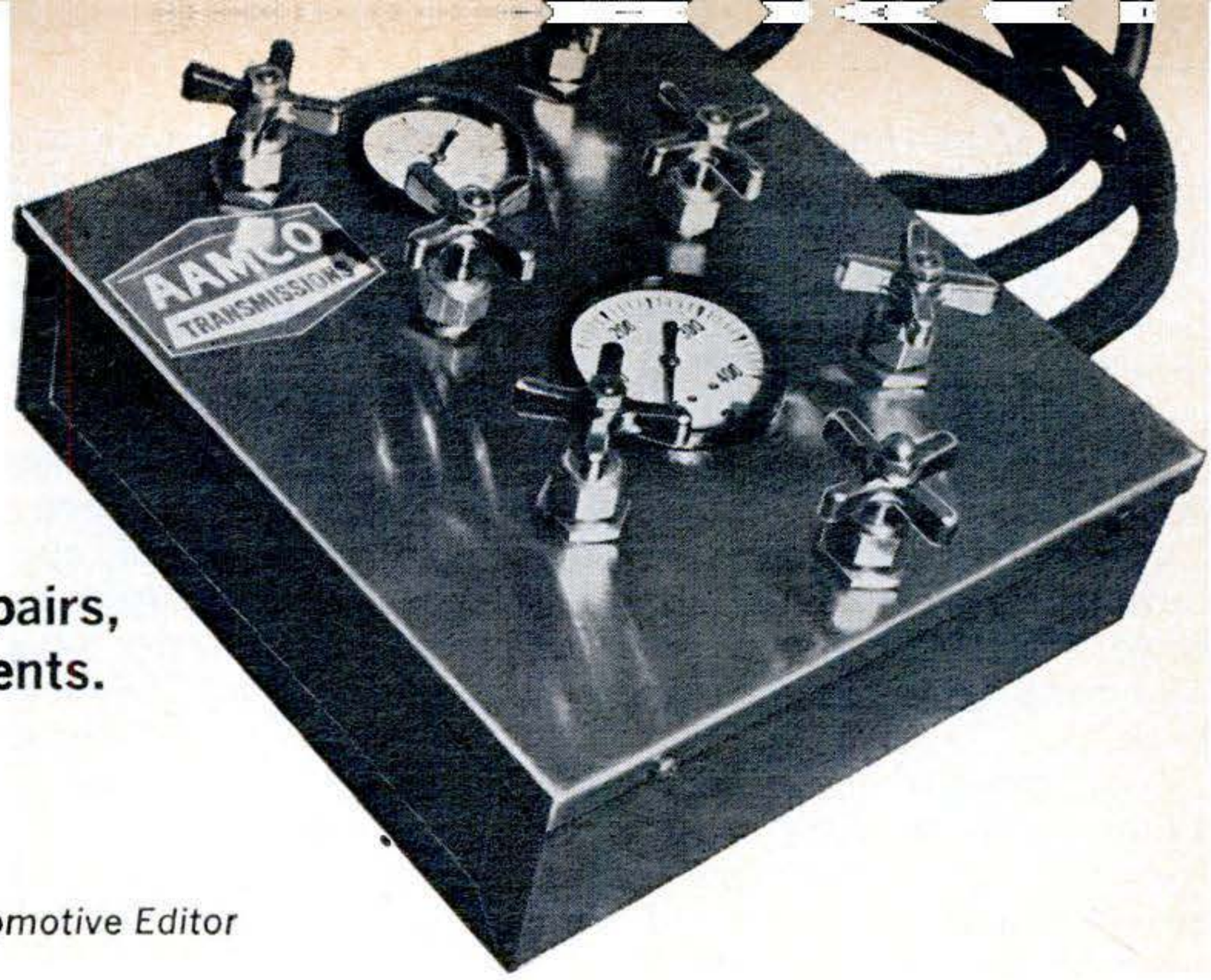


**Malfunction simulator,** with valve body, is connected to transmission control unit via hydraulic hoses, and to engine via a vacuum line.

# The most common transmission faults don't need costly repairs, only simple adjustments. These tests help you find the trouble

**By JAN P. NORBYE**/*PS Automotive Editor*

Is your automatic transmission acting funny? Does it fail to downshift on kickdown, and are upshifts too late? Does it judder when you back up? Do you get the feeling that the engine is losing power?

These symptoms may give you visions of a $250 repair job, or possibly a whole new transmission. Perhaps you even hesitate to have your dealer or garage look at it, for fear of a staggering repair bill.

Take heart. The symptoms I've mentioned may be caused by something as simple as faulty band adjustments or faulty engine connections—things that can be corrected with the transmission in the vehicle.

I found the answers to all the typical transmission complaints I have experienced the day I went on a test drive with Mike Ratz, chief technician of Aamco Transmissions. In fact, Mike demonstrated all the common faults on a car with its transmission in perfect order. He did it by playing tricks with an innocent-looking box, held in his lap, that he calls a "malfunction simulator." It was, of course, hooked up to the transmission. He invented it not for fault-tracing but for training transmission experts to recognize symptoms.

What is the malfunction simulator? It's a hydraulic valve body that corresponds to the control unit in the transmission, the "brains" that do your shifting. By turning one of seven faucet-type

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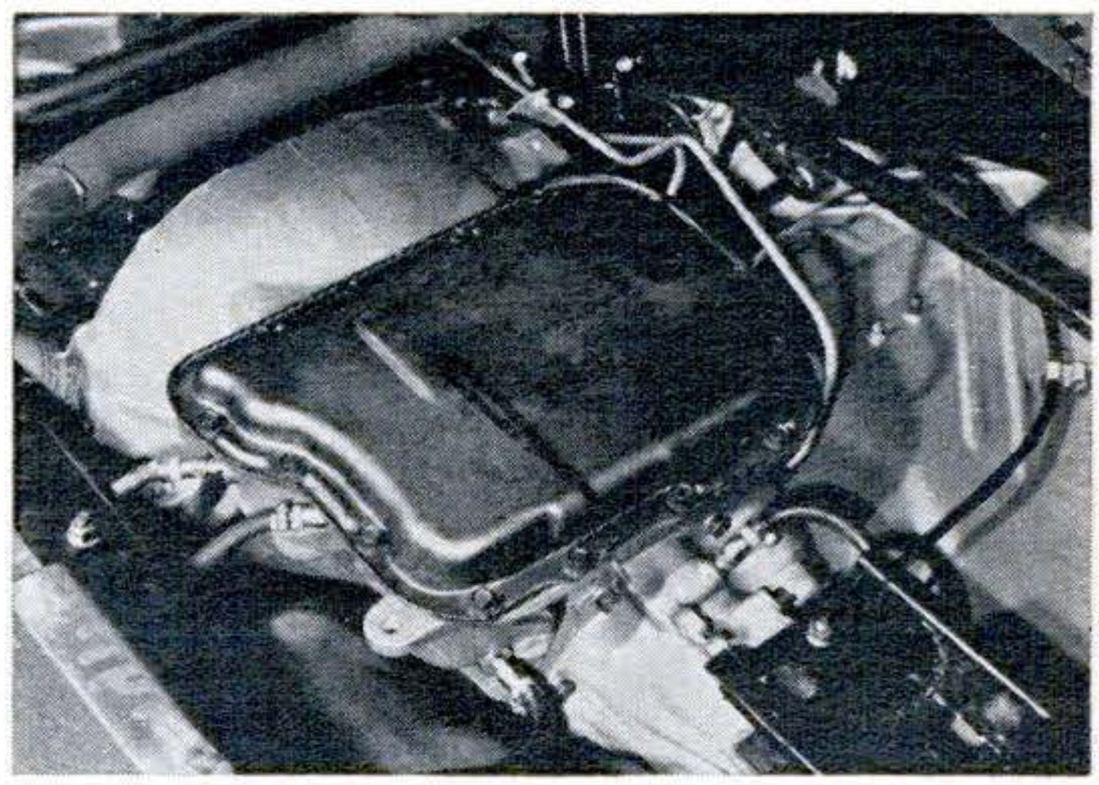
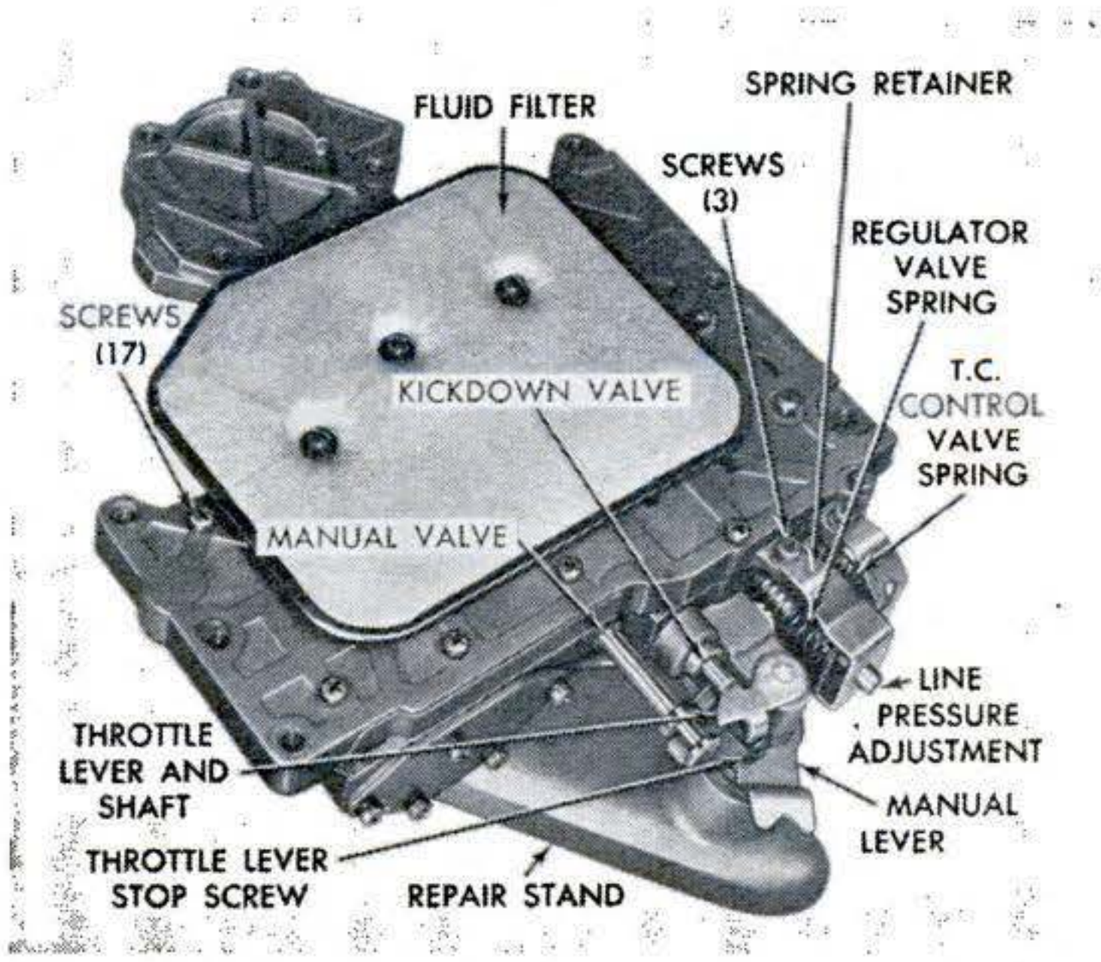


**Hoses under car** are linked to different parts of transmission: low and reverse-band apply servos, front clutch accumulator, and governor. One hose dumps transmission fluid back into reservoir.




**Details of the control unit,** removed but still fully assembled, can be clearly seen in this photograph. Most adjustments of the control unit can be made with the entire transmission in the car.



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handles, Mike could over-rule the control unit and make the transmission misbehave in the most frightening ways.

**Lack-of-power test.** I was driving the test car—a '68 Plymouth Fury—along a country road at about 50 m.p.h. when I suddenly noticed a loss of power. Engine speed fell. I floored the accelerator but the car was still slowing down.

I parked, and Mike explained: "I turned this handle, which applied the reverse band. That gave you partial engagement of reverse, holding the car back."

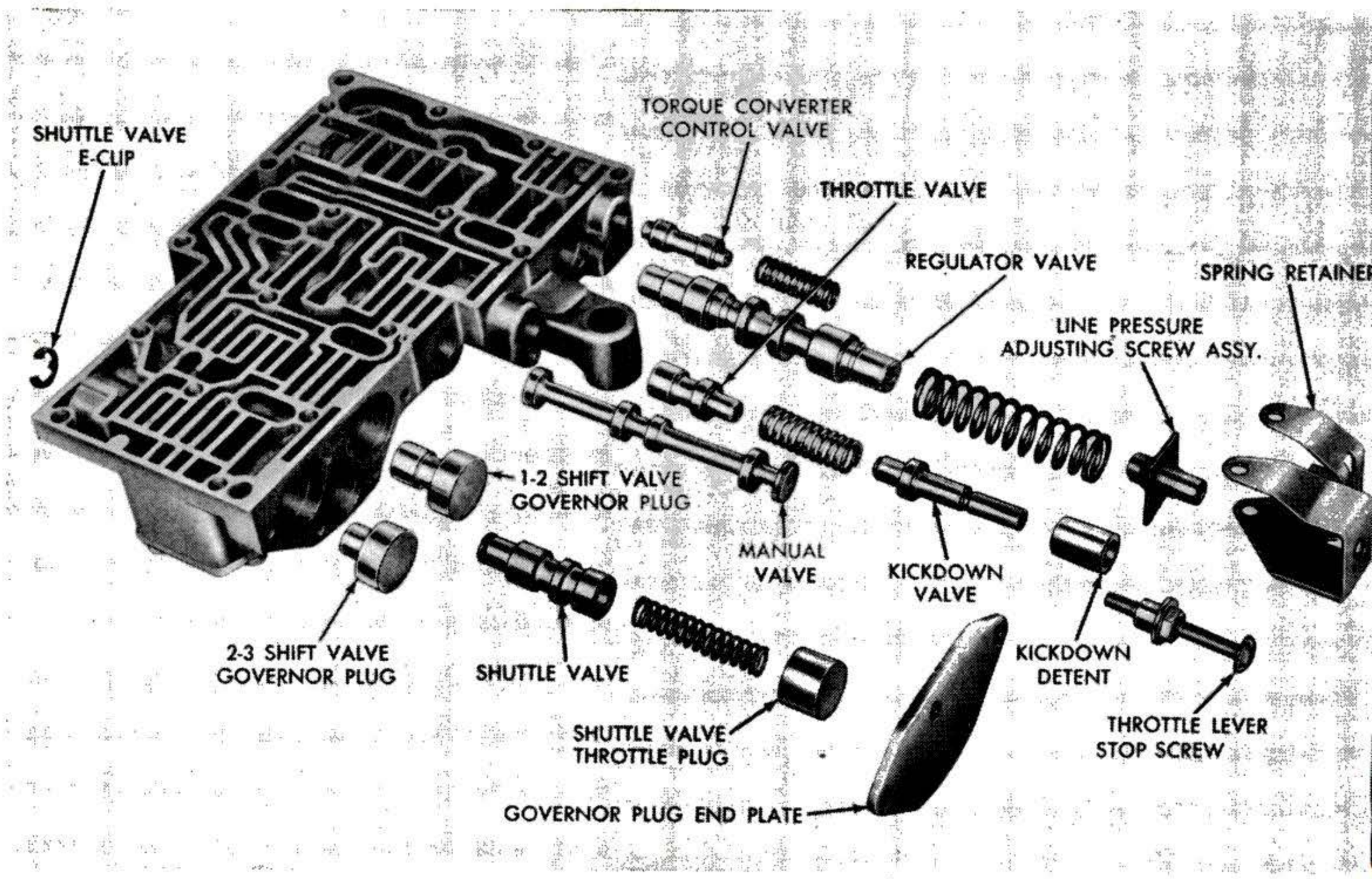
You know, of course, that the TorqueFlite used in the Fury consists of a torque converter plus two sets of planetary gears, giving three forward speeds and reverse. But the reverse *band?* That's simple: The rear planet-gear carrier is held stationary for reverse. The planet carrier is integral with the drum that contains the gears, and the drum is surrounded by a brake band that contracts and thus locks the drum to the transmission casing.

That's the reverse band. It's applied by hydraulic pressure from the control unit. What Mike did was turn some pressure on the apply servo for the reverse band at a time when the control unit normally would not dream of doing anything like that.

Cheating? Not really. The lack-of-power complaint usually arises *after transmission repair work* and means that somebody goofed. Most often, the reverse band has been set too tight. Or the reverse-band apply servo is "hanging"—locking up or not releasing properly. It's a half-hour job, at worst.

This lack-of-power complaint is not the same as "slippage in Drive." With slip, engine r.p.m. go up at the same or lower road speed. It occurs most frequently on long uphill grades. And this is *not* a small job. You've got worn clutch plates, hard clutch seals, a pump defect, or possibly a converter problem. In any case, you're faced with a big job: The transmission must be taken apart.

Clutch plates? Clutch seals? In an automatic transmission? As a matter of fact, the TorqueFlite contains two multiplate clutches. The rear clutch is interposed between the two gear sets, and the front clutch rides in front of the gears, inside a drum surrounded by the front




**Control-unit valve body** is immensely complicated, but needs no maintenance as long as your transmission fluid does not deteriorate and cause the valves to stick or the channels to get clogged.



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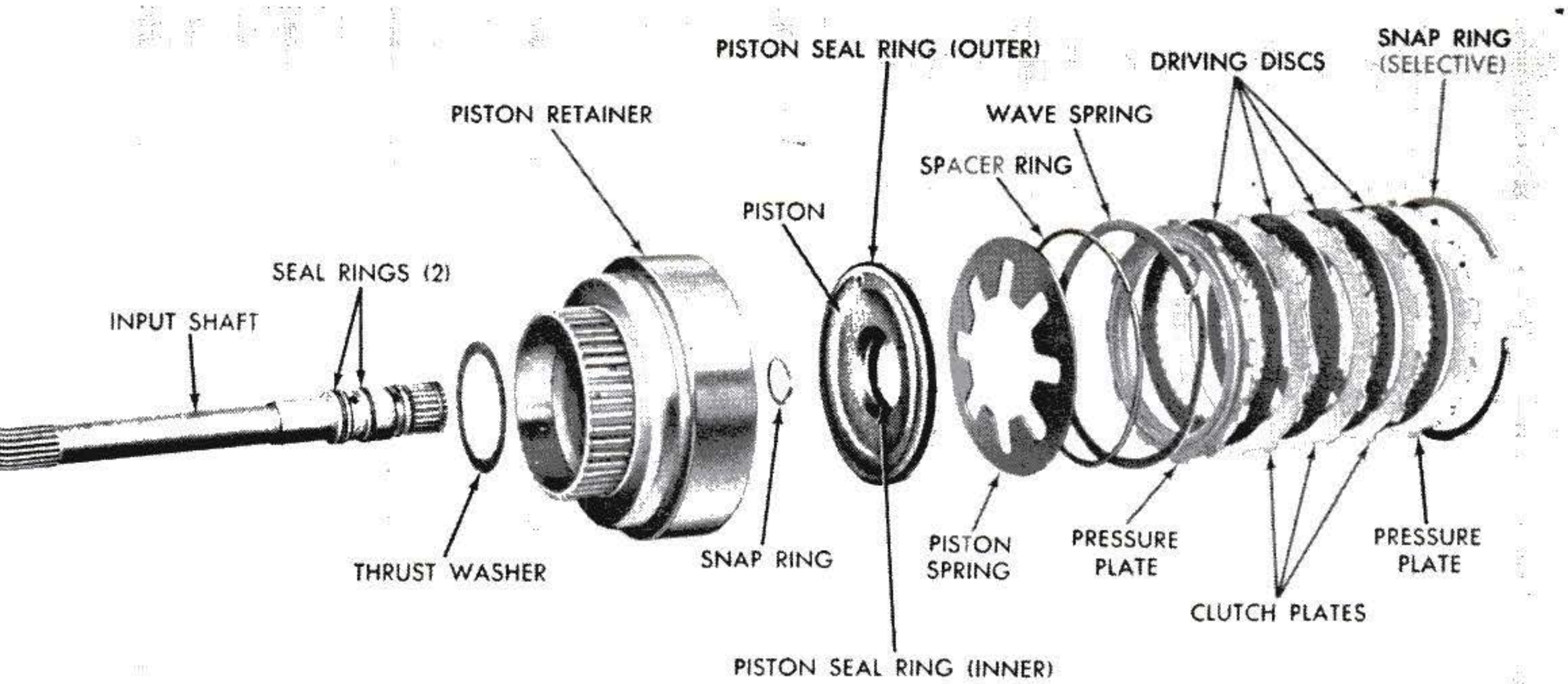


**Front clutch assembly** works by hydraulic pressure applied against the piston (in the middle) by an accumulator. Clutch plates and disks are hard wearing—the most critical parts are the seals.

band (or kickdown band). The two clutches, like the bands, are engaged by hydraulic pressure from the control unit. Disengagement is automatic when pressure is cut off.

**Rough downshift when stopping.** This has probably happened to you many times. You are gently pulling up at a stoplight, when *bang*—in comes low range with a kick.

The fault doesn't have to be in the transmission at all. Check first for excessive idle speed or a sticking accelerator linkage. The most likely cause of the rough downshift is a loose low-range band adjustment. A good transmission man can fix a simple maladjustment like that in five minutes.

**Jerky drive when backing up.** We found a small parking lot that was not quite level. I headed for the fence at the low end, then went slowly up the grade in reverse. The car's motion was as smooth as silk.

"Do it again," said Mike, as he turned another handle. This time, I fed gas just as gently, but the car jerked and vibrated as if I had a manual transmission and a greasy clutch. After a few more tries, Mike turned the TorqueFlite back to normal.

He had simulated the malfunction by turning off pressure on the reverse-band apply servo, because this fault is usually caused by a loose reverse band. Less frequently, you'll find it's due to low fluid pressure as a result of a tired pump or faulty pressure adjustment. In any case, it can be corrected without removing the transmission from your car.

**Lack of power when starting off.** I made a full stop and Mike got busy with his faucets. When he told me to go, I stepped on the gas, expecting brisk acceleration from the V-8. But no. It was awful. The car moved, but it sort of oozed off the line —like a snail.

If this should ever happen to you, you can probably get it fixed in a few minutes. The most likely cause is a slipping low-range band. It could be due to low pump pressure or to foaming of the fluid, but then you'd have other trouble symptoms as well.

**No upshift or late upshift.** When you have this trouble with your transmission, you have it only with a cold engine or with a hot engine, but not both. The first condition is the most common. You start in the morning, and you don't get into top gear until the transmission has warmed up. This usually happens with older cars; it's an aging problem. Old seals harden.

The seals I'm talking about are inner and outer seal rings in the pistons that operate the clutches. If the seal rings won't seal because they're too hard, the clutch is rendered inoperative until they warm up. When the transmission is hot, the seals are pressed against the

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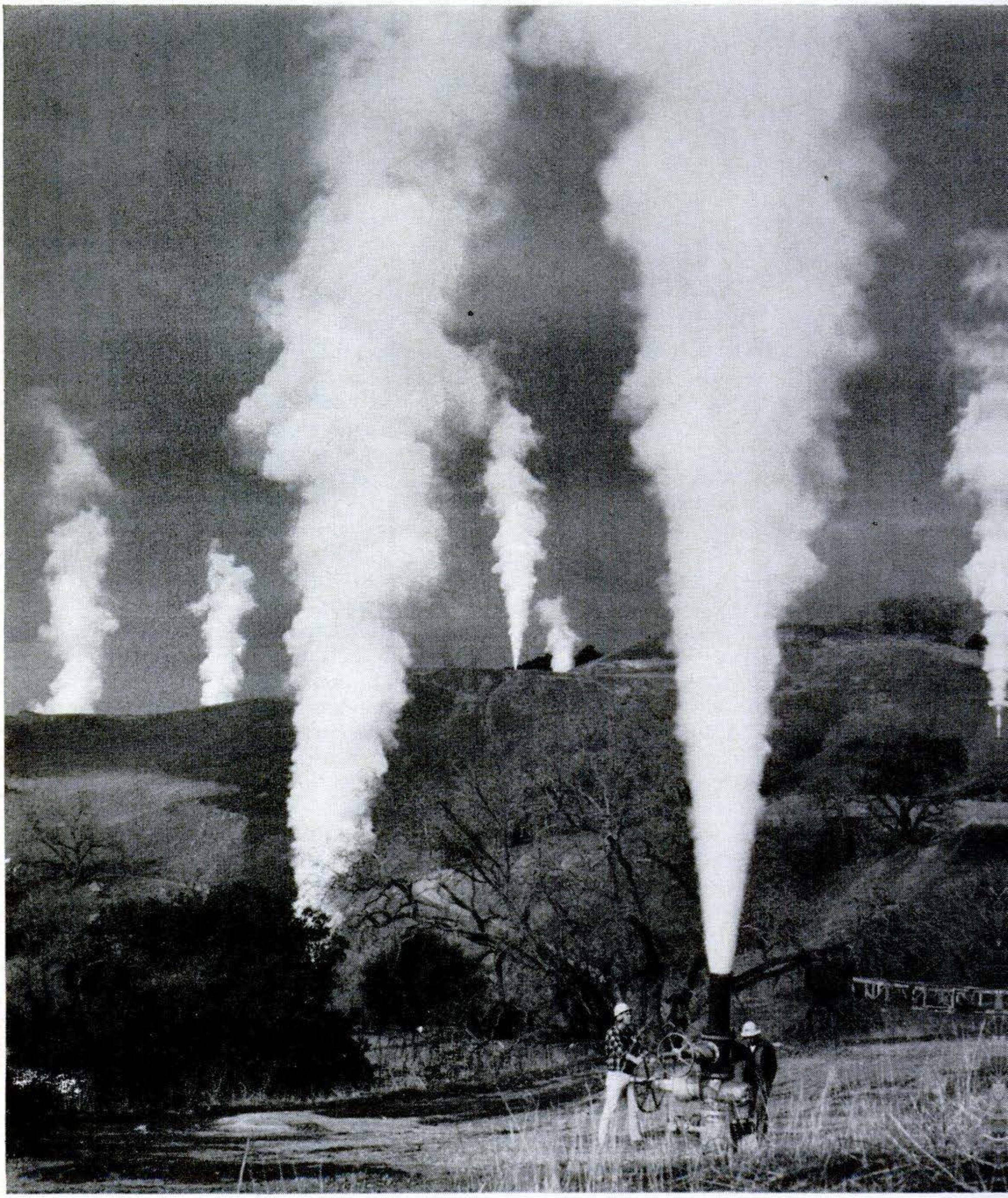
## Our hottest treasure hunt yields

# Cheap Power from



**In a test of steam pressure** at The Geysers, Sonoma County, Calif., workmen opened valves on wellheads and left them open for three weeks. Wells feed a Pacific Gas & Electric Co. geothermal generating plant.



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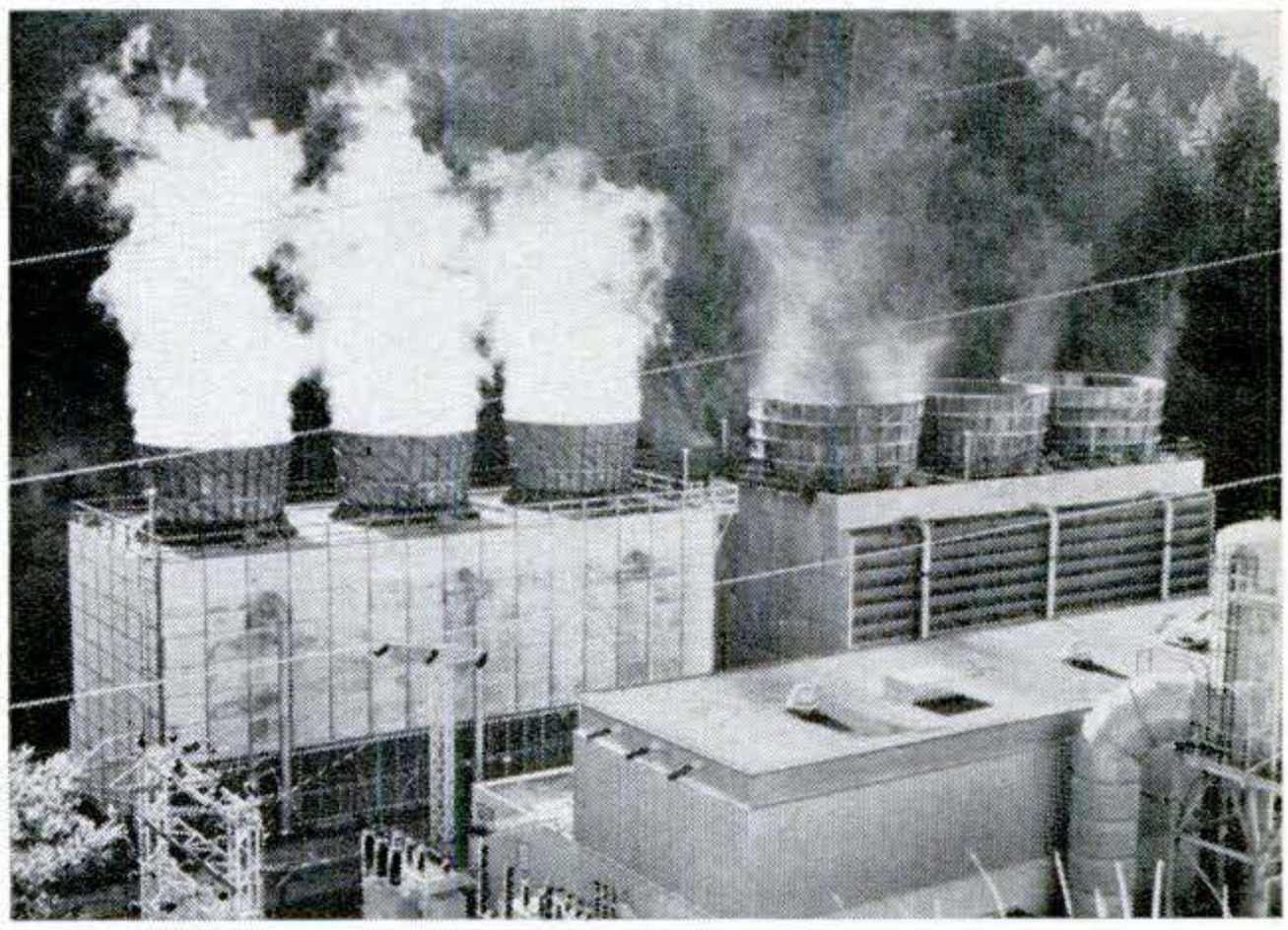
**Created deep in the earth by molten magma, superhot geothermal steam is being put to work making electricity**

# Underground Steam

By WILLIAM M. HOLDEN



**Vapor issues from cooling towers** at geothermal powerhouse. Building in right foreground houses turbine-driven generators.

Man's search for cheap energy has taken a dramatic new direction. Night and day, seven days a week, oil-type drilling rigs are grinding deep into the earth searching for subterranean steam to spin generators. The search now covers every continent (except Antarctica and Australia), the bottom of the sea, and even, paradoxically, the craters of the moon.

Earth's center may be as hot as the sun's surface. Where molten magma (rock material) invades the upper crust, hot spots such as volcanoes, hot springs, geysers, and fumaroles (steam vents) are formed. Surface water percolating down to rocks heated by magma is turned to steam, adding to the small amount that boils out of the magma itself.

Today this energy is tapped only at the hot spots. Tomorrow it could be tapped anywhere just by drilling deep enough. For only 20 miles of crust insulates us from a caldron of unthinkable energy.

**Big boom in steam.** There's a lot coming, but look at what's already happening:

- At America's first geothermal power plant in California's Sonoma County, Pacific Gas & Electric has been making power from natural steam since 1960. By 1975, PG&E's expanding earth-energy powerhouse will be a $50-million complex pouring out 250,000 kilowatts. That's enough to "turn on" San Francisco.
- In the same area, three other companies have struck steam and a fourth is drilling for it. One, GRI, hopes to sell

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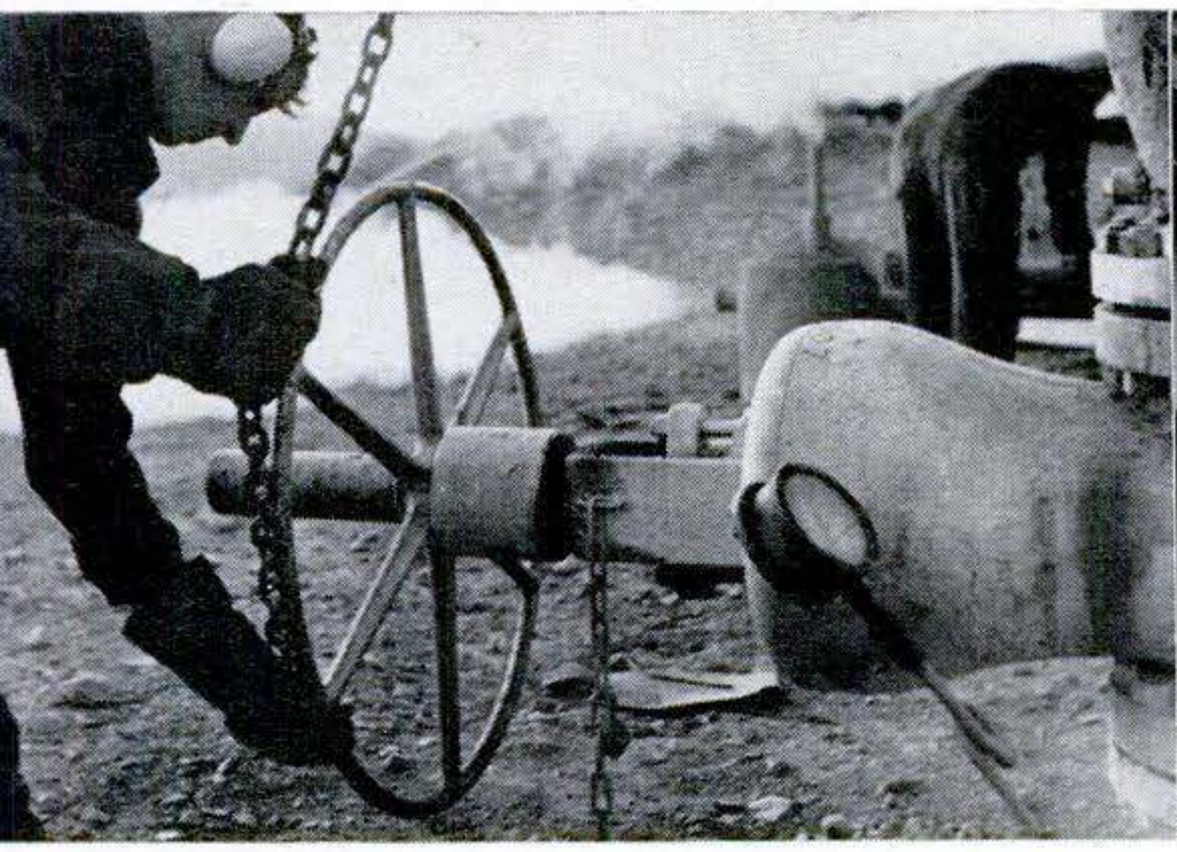
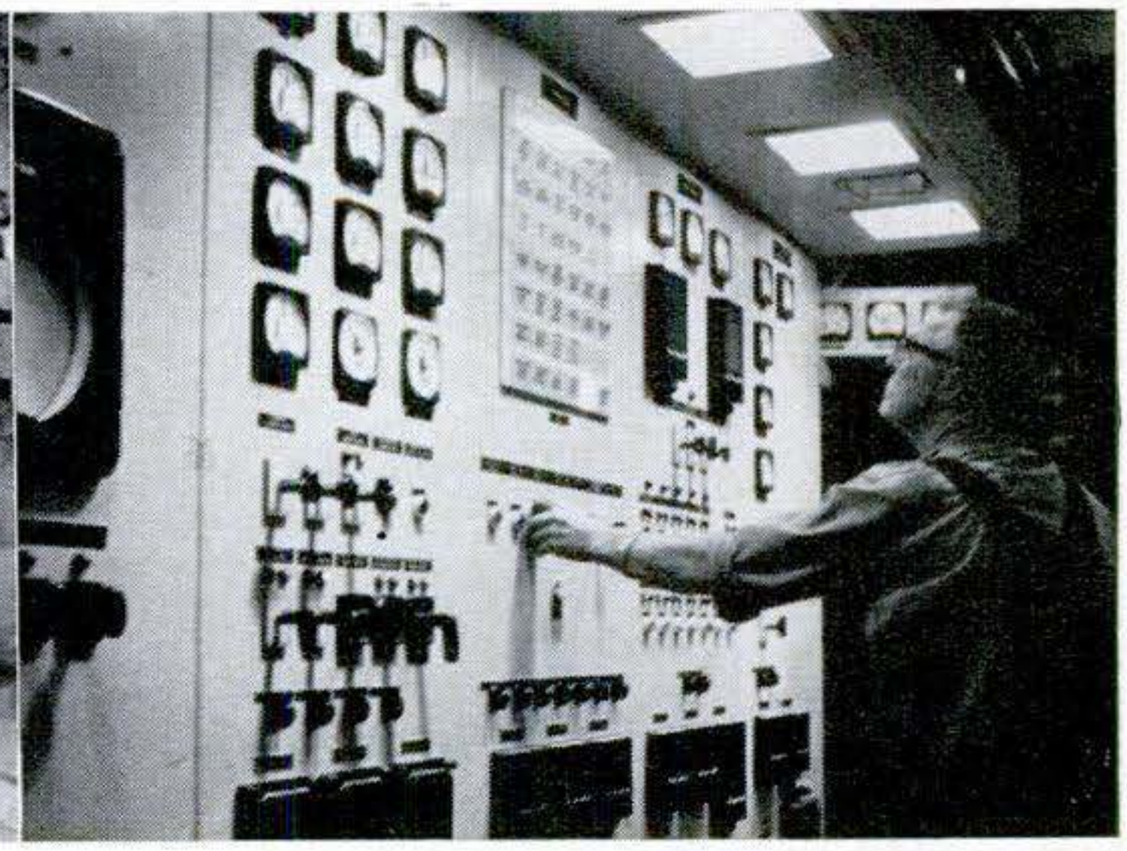


**Ear caps shut out shriek** of escaping steam as workmen close valves following tests of well pressure.



**Main control panel** at powerhouse that monitors generation of power from steam is checked above.



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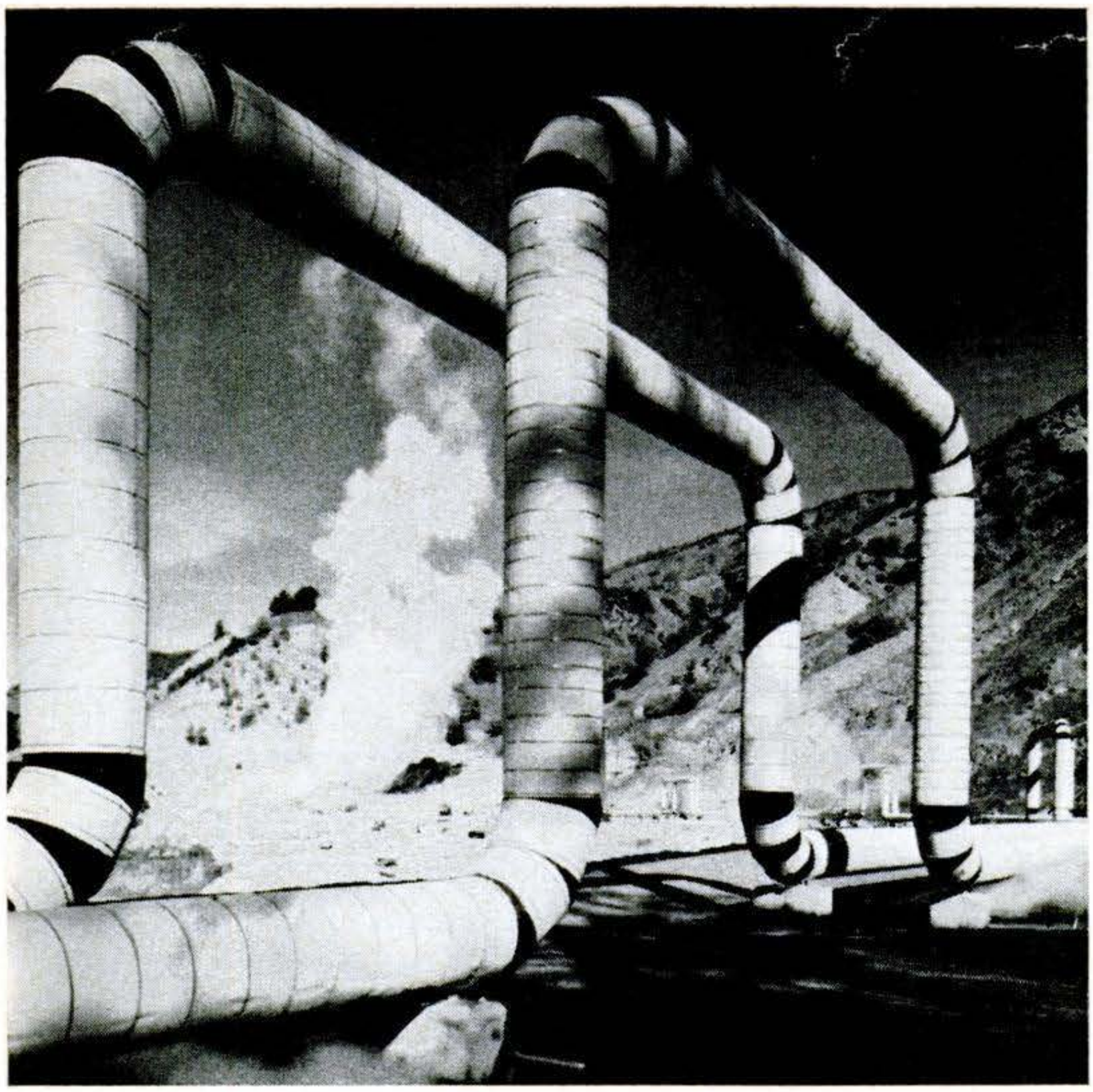
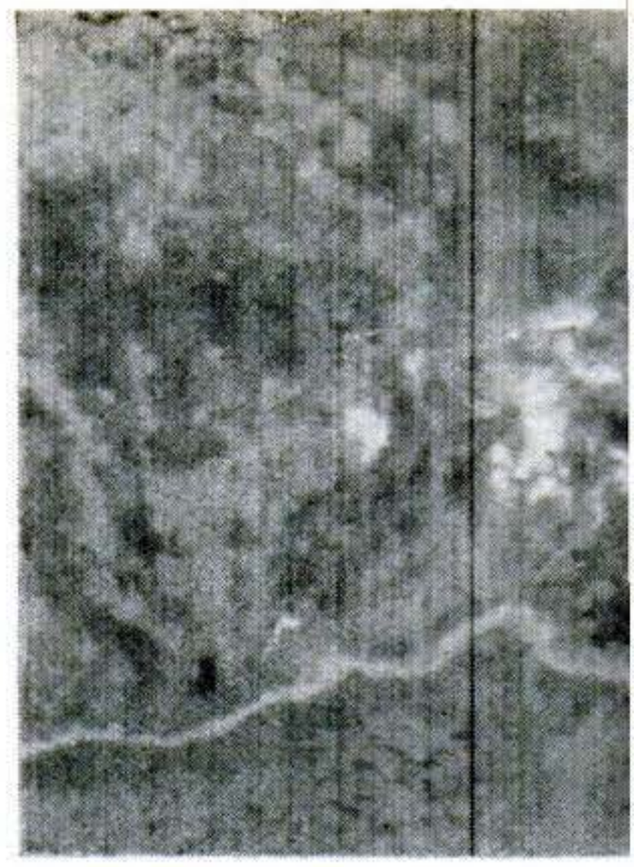


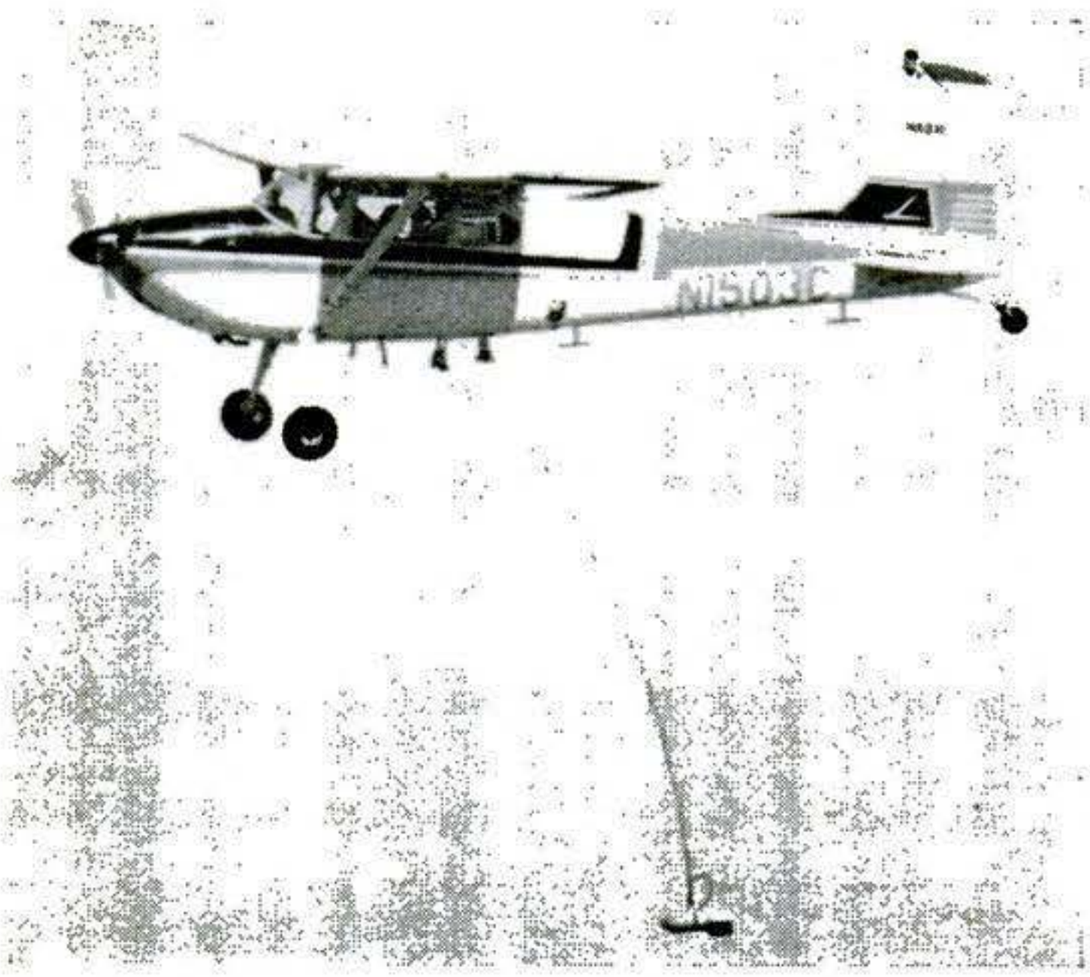


**White splotches are geo**

**Huge loops** (left) allow for heat expansion in insulated-pipe steam-gathering system at The Geysers. Pacific Gas & Electric Co. plant was first U.S. geothermal plant, started making power in 1960. By 1975, PG&E's output from underground steam will be 250,000 kw.

300,000 kilowatts of geothermal electricity to the Federal Bureau of Reclamation for use in northern California.

• Both steam for electricity and mineral-rich brines are expected to result from a $30-million venture near the Salton Sea, Calif. Morton International will drill mile-deep wells, extracting a mind-boggling treasure from the yellowish brines. Silver alone may be on the order of the Comstock Lode, but the brines are also laced with sodium, calcium, and potassium chlorides; manganese, strontium, boron, lithium, barium, gold, zinc, lead, copper.



**Magnetometer suspended from cable** is latest device in search for geothermal steam. Other airborne devices: infrared scanners, gamma-ray spectrometers.

• At what may be the world's largest geothermal field, 60 miles southeast at Cerro Prieto, Mexico, there is a similar alliance of brine and steam. A 75,000-kw. plant will generate electricity by 1970.

• Soviet engineers are thinking big. On eastern Siberia's volcanic Kamchatka Peninsula, a 25,000-kw. geothermal plant has been set up, one of 100,000 kw. is on the drawing boards, and a third project is being planned. Water, injected into the top of a permeable rock layer, will fall six miles. A well will tap resulting steam.

In western Siberia, engineers are tapping thermal waters from a vast reservoir. This is the curtain raiser, they say, for a colossal geothermal transformation of the lives of the shivering comrades in the frozen northlands.

• Some 400,000 kw. of geothermal power runs half of Italy's great web of elec-



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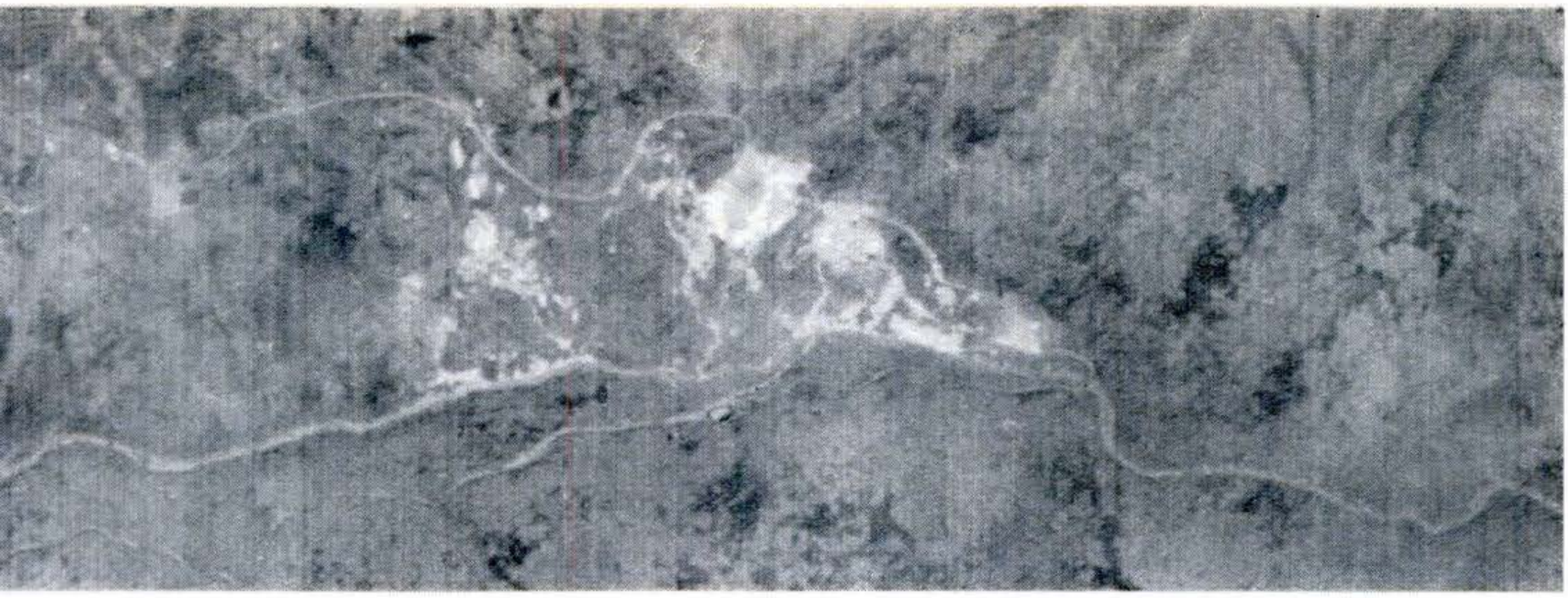
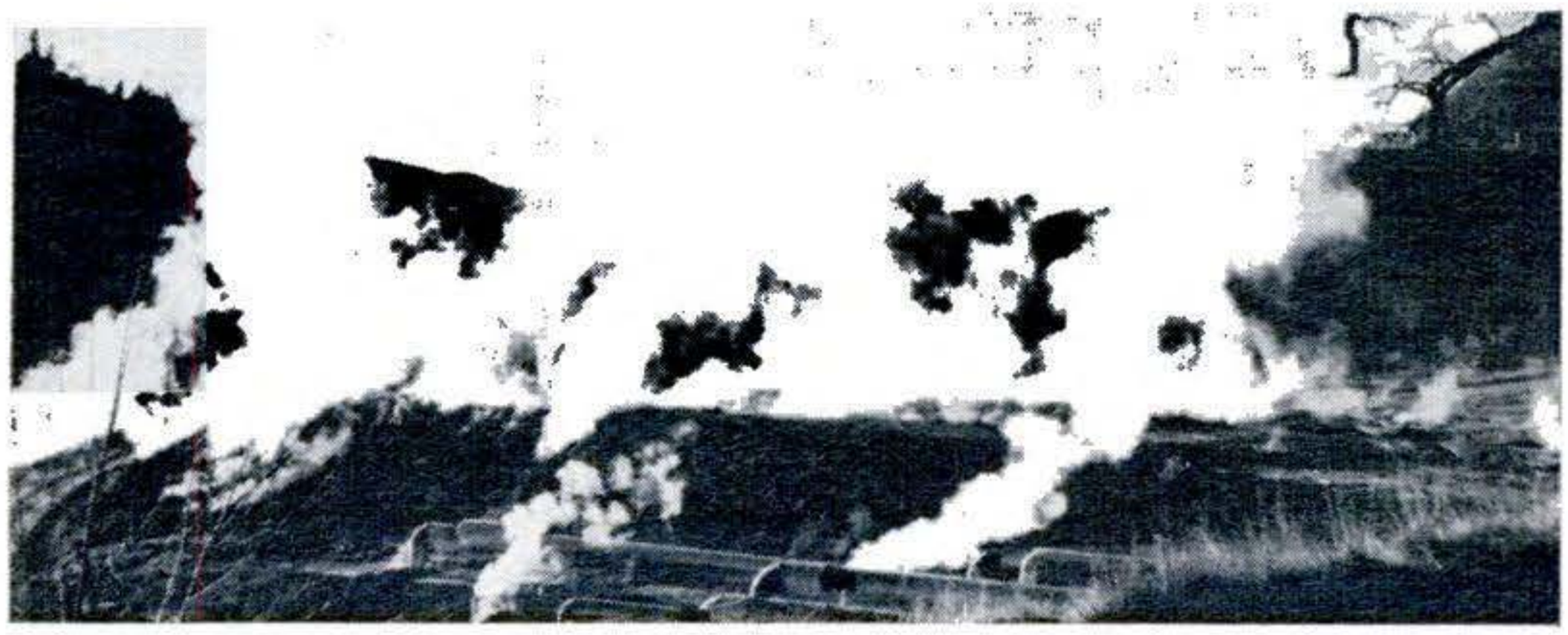


**hermal hotspots** seen by infrared film from 5,000 ft. along Big Sulphur Creek in California.



**White steam plumes** soar hundreds of feet from this wild well at The Geysers. For years, well has resisted efforts to harness it. Main reason: An early well pipe fractured at some depth, causing steam to push up elsewhere from loose ground. An effort is now under way to tame it.

tric railroads and helps make up for the lack of coal, oil, and water power. Italy pioneered in 1904 when Prince Ginori Conti lighted five bulbs wired to a natural-steam generator.

- A generating plant is being built in Iceland where natural hot water is already piped to the homes of 50,000. It's used for heating, cooking, bathing, laundering. It heats sidewalks, fills swimming pools, and warms 1¾ million square feet of greenhouses lush with flowers, vegetables, fruits—even bananas.
- A power crisis in New Zealand was avoided in 1958 by tapping the earth's boiler. Legend says the Wairakei area has been steaming ever since the fire goddess descended to rescue a Maori chief lost in a blizzard. Today the goddess' gift is used as it is in Iceland—and furnishes electricity, too.

**Prospecting for steam.** Even in the power-rich U.S., geothermal energy is becoming increasingly important. In our western states, 1,000 warm springs are tokens of a wealth of natural steam. Thermal waters warm homes in Idaho, motels in Montana, and resorts in Alaska. A recent study concluded that this energy could become New Mexico's major power source.

Most geothermal resources are on federal lands, and absence of laws permitting drilling there is the biggest damper on the geothermal boom. The U.S. Geological Survey has designated a million acres of federal lands with potential geothermal resources. They're in California, New Mexico, Nevada, Montana, Idaho.

There are a number of geothermal projects on private and state lands, however, with more in the offing. Geologists compare their present pioneer status with that of petroleum a century ago, when drilling was limited to places where oil seeped from the ground. The gusher era in oil, which came after years of research and exploratory drilling, may be followed by the gusher era in steam.

The cheapest exploration technique, in the absence of obvious hot spots, is the poor-man's survey: Wait till it snows, then look for melted patches. At the other extreme are probes with instruments measuring gravity, electrical resistance

[Continued on page 200]



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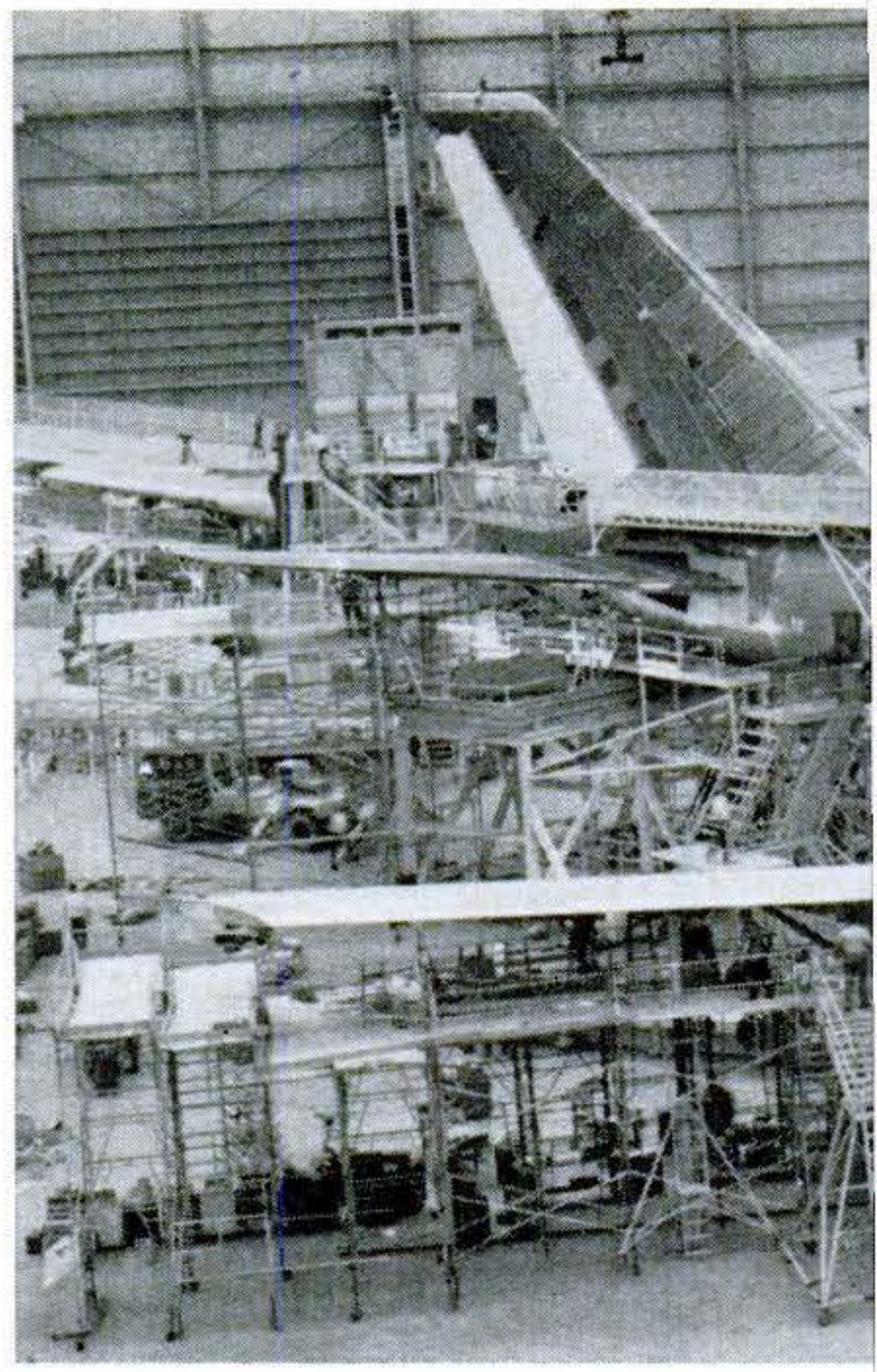
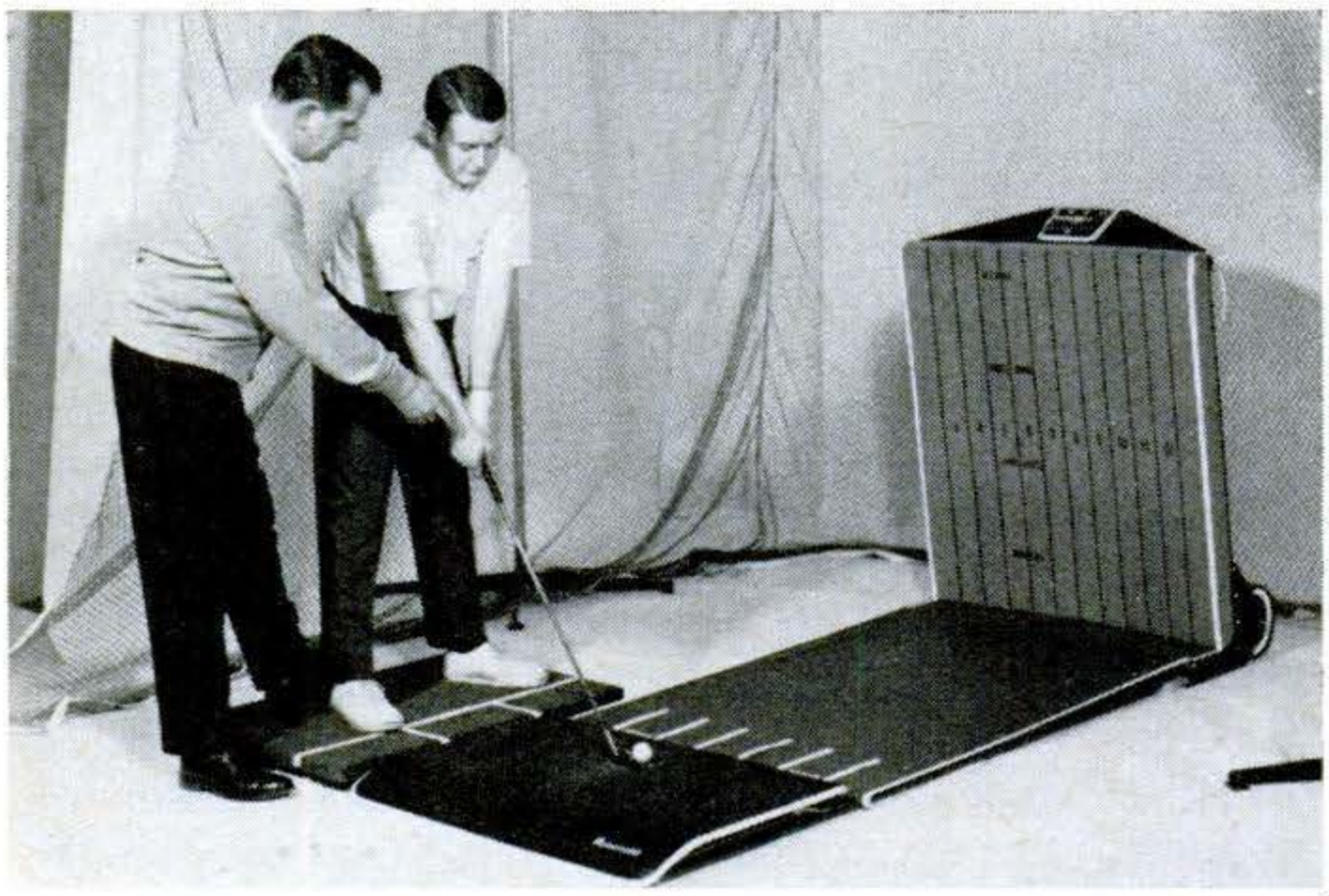
## Single-lens-reflex camera uses cartridges

This new Kodak Instamatic reflex camera is designed for both the amateur who wants drop-in cartridge loading and the expert who wants interchangeable lenses and through-the-lens viewing and light metering. The camera comes with a 45mm *f*/2.8 lens ($200) or 50mm *f*/1.9 lens ($250). Other lenses range from 28mm to 200mm. Electronic shutter offers speeds from 20 seconds to 1/500.



## Jumbo passenger jet almost ready to fly



## Computer range takes "iffies" out of golf practice

A new electronic golf range by Brunswick permits you to practice with every club in your bag and gives you accurate information showing yardage, direction, and degree of hook or slice on every shot. A sensor in the backstop feeds information into an analogue computer, which analyzes the shots for direction and velocity and tells the golfer how he made out.

## Cops get a dome light

Japanese motorcycle cops are being outfitted with these new helmets, which have a flashing light on top. Police can use the light to flag down drivers or to control traffic on heavily traveled city streets.



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Biggest commercial airliner, recently rolled out, is shown at Boeing assembly plant—largest in the world under one roof—at Everett, Wash. The 231-foot-long four-engine jet will carry 350 to 490 passengers, depending on seating arrangements. In construction photo above, fuselage is joined to wings and tail section as the No. 1 airplane nears completion. Twenty-six airlines have ordered 157 of the mammoth 747s.

## Sliding-top trailer for easy loading

The walls and roof of the Skinback trailer slide almost off the bed when you loosen a couple of pins and chains and drive forward. This leaves a flatbed for easy loading. When everything is aboard, you back up the tractor, sliding the skin into place, and lock it. It's cheaper than tarps, says the maker, Stewart Laprairie Skinback Trailers, Ltd., North Vancouver, B.C.

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# Anybody in Your Family Worried About ACNE?

**Here's what science is doing about this disease that affects millions. Plus up-to-date answers to common questions**

By JAMES H. WINCHESTER

Acne can be a tragic disease. At any given time, it can make life miserable for 60 to 90 percent of all those between 12 and 21. And it affects a smaller, but significant, percentage of older persons.

One out of every five visits to dermatologists today is for the treatment of acne, but the anguish caused by this widespread ailment is far more mental than physical. At a time of life when people are most concerned about their appearance, its psychological effects too often send the sensitive into spins.

Acne starts at puberty and continues until the end of the college years and sometimes on through adulthood, affecting both sexes. Waiting to outgrow acne, however, can be a serious mistake. Bad cases result in permanent scarring.

Let's see what science is doing to combat this ancient scourge. Here are the most-often-asked questions about acne, and the latest answers, supplied by leading dermatologists and specialists in teen-age medicine:

### What is acne?

It's an unfortunate side effect of the growing-up process. With the onset of the teen-age years, the internal glands produce increased amounts of hormones, which stimulate the oil glands—located mainly in the skin of the face, chest, and back—to grow in size and activity. The horny layer of the skin thickens at the same time, and this thickening impedes the escape of oil to the surface of the skin. There is a bacterial buildup around blocked pores, and acne results.

But keeping the skin as clean as possible won't prevent acne—or cure it. Despite the emphasis on cleanliness to combat skin troubles, they are not caused by dirt. The continual washing recommended in acne treatment merely removes stagnated oils and clears out clogged-up glands.

Today's fad for hair streaming down the sides of the face causes bacteria to collect excessively in the small sores caused by the disease. At the same time,



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ne smothering strands increase facial emperature, causing the germs to grow. Result: a new type of acne, called "Bea- e Forehead."

"For such cases," says one prominent ermatologist, "I say, 'Get a haircut!'"

### s there any hope from ne new drugs?

Antibiotics and the sulfonamides, tak- n by mouth, act on the body as a whole suppress bacteria that produce fatty cids, and have done much to improve ne management of acne.

Antibiotics in soaps and other prepara- ons for local application do not seem to ave much effect. Some products, in fact, o harm, causing photosensitivity, a con- ition in which the skin reacts abnormally light, especially to ultraviolet rays or unshine.

Good success in clearing up acne sores as been achieved by injection of a corti- osteroid directly into the abscess. Drs. oseph A. Witlowski and Lawrence C. arish of the University of Pennsylvania Iedical School reported this year that ithin a week after a single shot, lesions most always disappeared. No sores re- urred and a slight pitting of the skin be- ame almost imperceptible.

Estrogen, the female sex hormone, is ery effective in suppressing the sub- ances that produce the acne-causing ormones in the endocrine glands. The ew contraceptive pills—or other estro- ens—are sometimes used in treating irls, despite such side effects as nausea, oreness of the breasts, and delayed or ncreased menstrual flow.

Many doctors claim that effective mounts of estrogen tend to produce fem- nizing results in males, but Dr. Elmer H. uttle of the University of Rochester chool of Medicine reports that, by care- ul control, manhood need not be threat- ned. He stated recently in the New York tate *Journal of Medicine*: "Enough of ur male patients who have received it re now fathers so that we do not hesi- ate to continue its use."

Preparations containing sulfur, prefer- ably as a lotion rather than in a greasy ointment, help remove blackheads. The best way to apply them is on a hot com- press, left on the face for five minutes morning and evening, but they are effec- tive used as a lotion directly. Most der- matologists recommend them highly.

Where acne produces cysts, Vitamin A, in doses of 100,000 units a day for a period of six to nine months, softens them, making them easier to treat.

### What role does sexual activity play in acne?

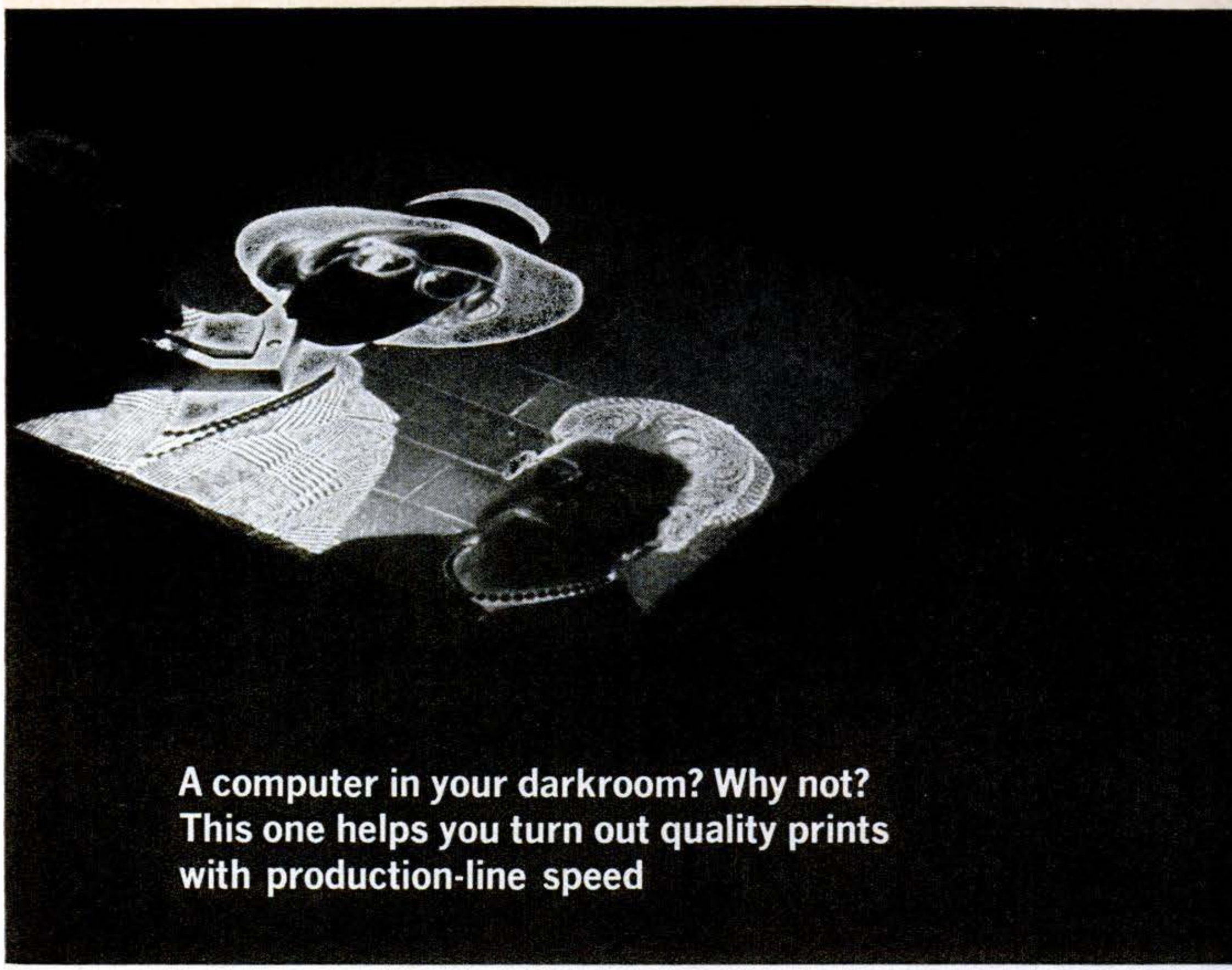
This is a very important point to make clear to young people plagued with skin problems. While it is unfortunately true that these problems begin at puberty, sexual activity of any kind has nothing to do with the natural chemical process that causes acne. This specifically includes masturbation, a frequent cause of guilt feelings that intensify the anguish of youngsters suffering from acne. It's bad enough to have the skin trouble, but all doctors stress that "acne is no cause for guilt."

### How effective is home treatment?

Mild acne usually responds to the fre- quent gentle use of soap and water. The face should be washed four or five times a day. Frequent shampooing of the hair and washing of hands also help. Wash- ing with hot water is more important than the kind of soap used. Any mild, neutral soap is satisfactory. Many spe- cial detergents, some with antibacterial drugs added, are offered as soap substi- tutes, but doctors doubt their value.

When a breakout occurs, it should be left alone (except for the cleansing de- scribed). This is not easy, but home treatment—opening the sores or removing the crust from a sore that's beginning to heal—is likely to spread the infection and lead to scarring. In severe cases, a der- matologist is needed. He will work out an individualized program of control.

[*Continued on page 196*]



A computer in your darkroom? Why not? This one helps you turn out quality prints with production-line speed

PERSONAL-USE REPORT:

# • Heath Colorval Darkroom
# • Omega A3 Enlarger
# • Kodak Instamatic 814

By EVERETT H. ORTNER/*PS Photography Editor*

## HEATH COLORVAL

The trouble with hobbies is that they involve work. In the darkroom, the perfect print is usually preceded by test strips, badly exposed prints, prints on the wrong paper, and other nuisances that add up to irritation, frustration, and time lost. The Heath/Mitchell Colorval Darkroom Computer (Mitchell is the inventor, Heath the manufacturer) is a work-saver, time-saver, paper-saver, and, if you have a bad temper, even a marriage-saver.

With the device programed to work

*Continued*



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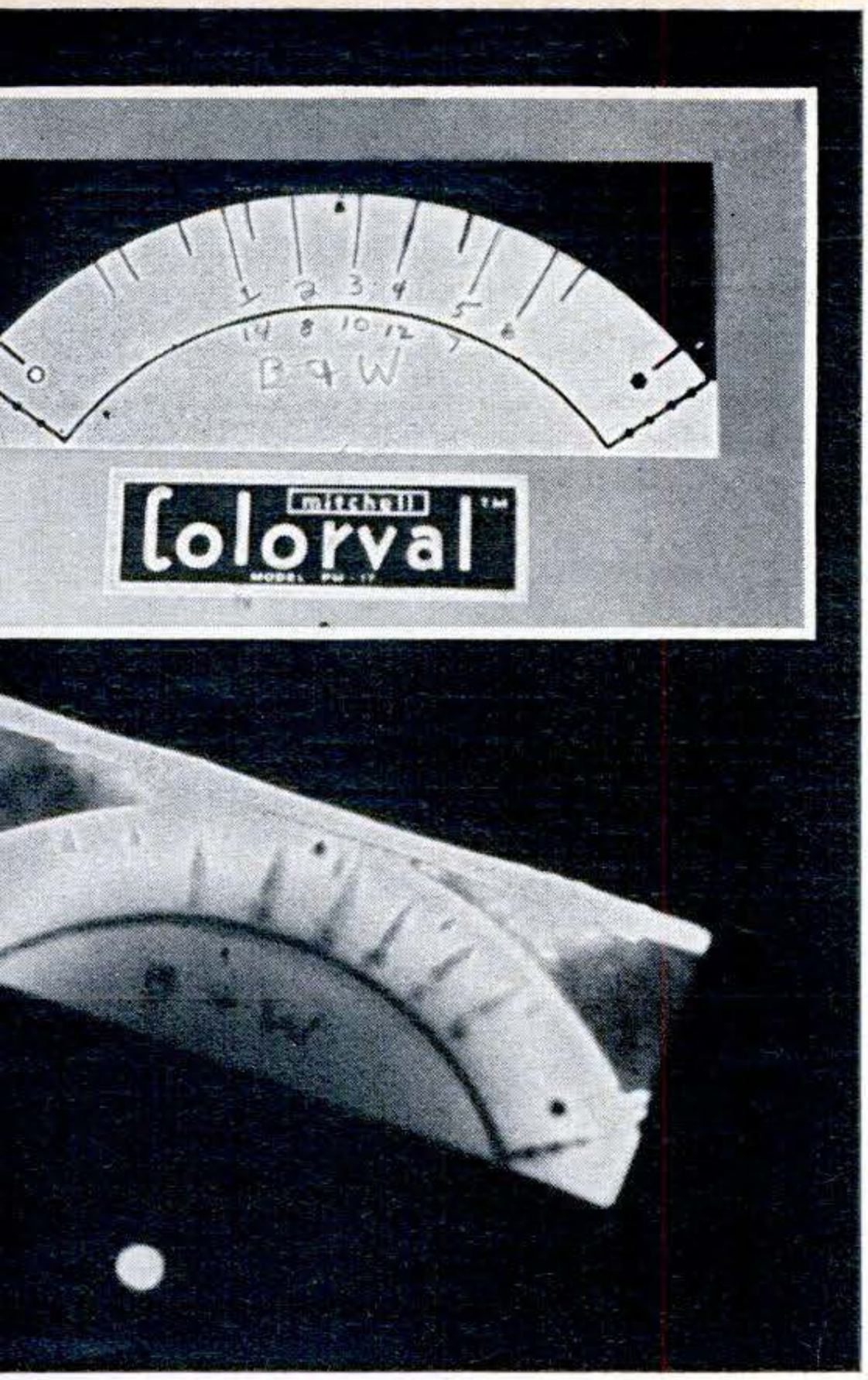
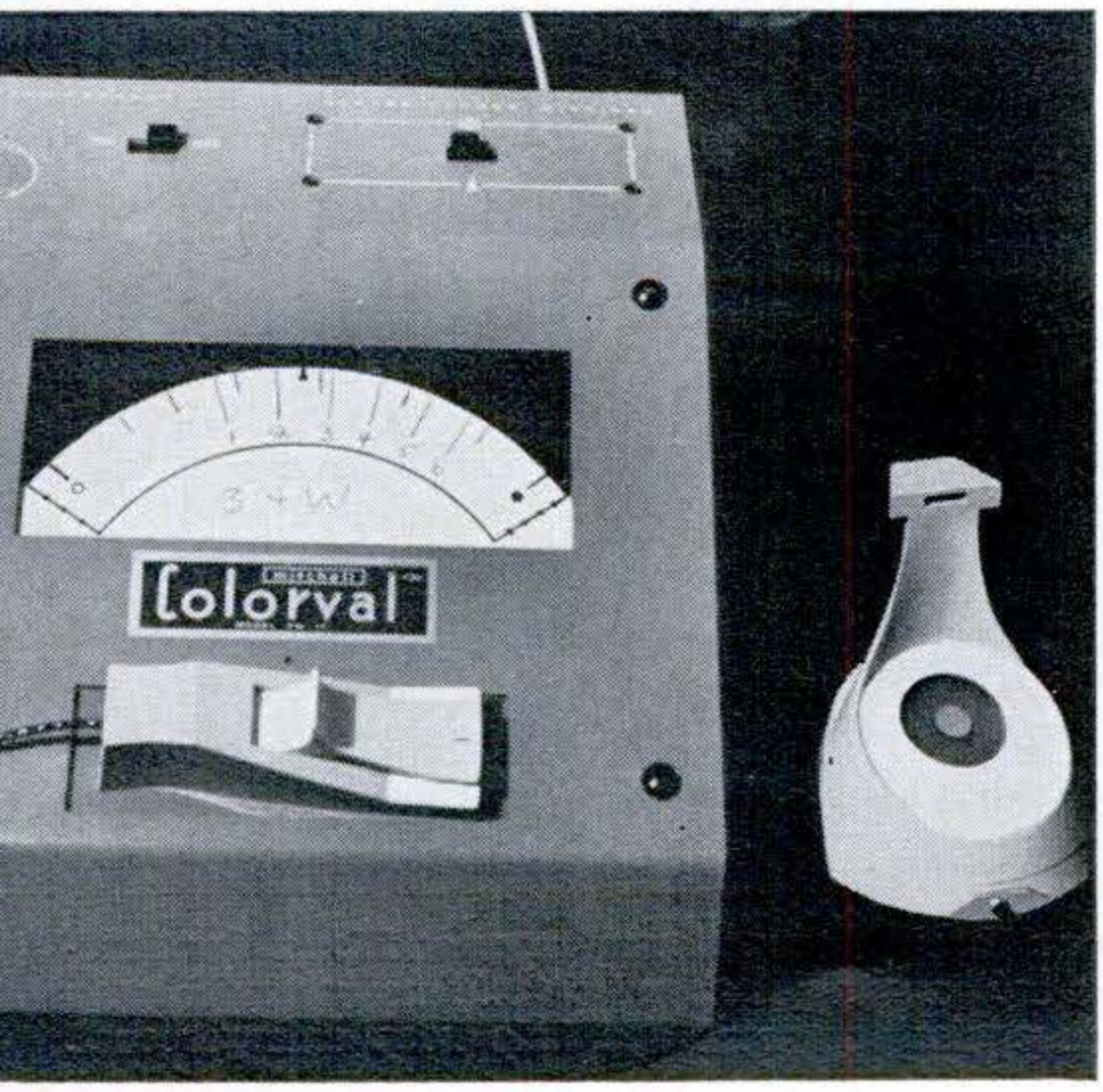
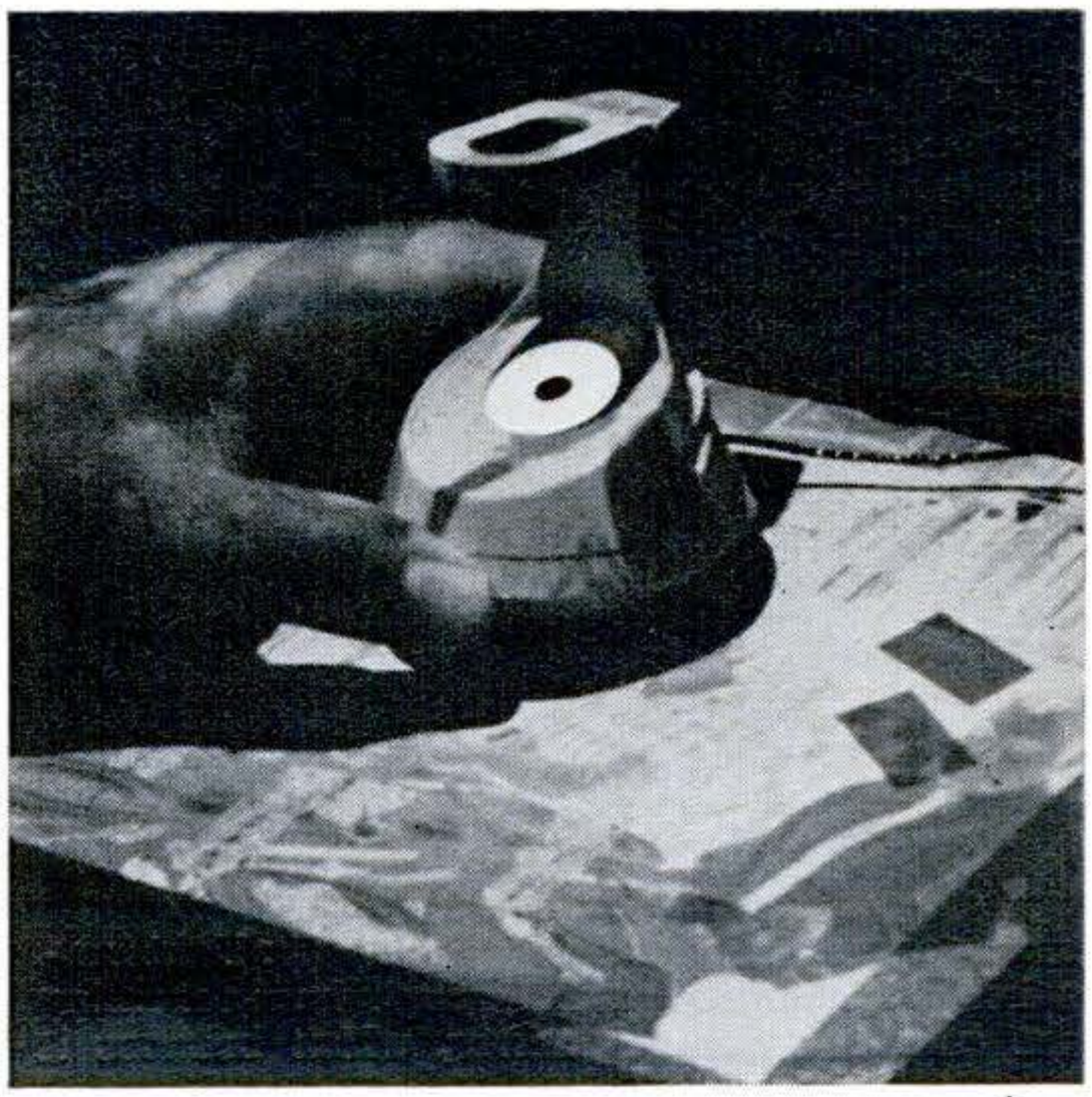



**Perfect exposures,** every time, without trial and error, are possible with the Colorval once you have programed it to suit your enlarger, your paper, and your developer. (Instrument is shown at bottom left with exposure probe resting on it, color probe next to it.) It is a supersensitive light meter that enables you to adjust enlarger light output so that the same intensity falls on the paper every time, with every negative. Exposure time with each paper grade never varies. In addition, by measuring the difference —contrast—in the intensity of light coming through the thin areas of a negative and the dense areas, it suggests what contrast grade of paper to use. The Colorval has two exposure circuits: one for black-and-white, one for color negatives. Initially the meter needle is adjusted until, at high enlarger light output, it rests at far right (on the star; see inset at upper left); and at one-eighth that output, or three *f* stops, at the middle position (delta). The scale is then calibrated by *f* stops, using neutral-density filters over the exposure probe, and then by paper grades. Finally, you determine, by test strips, the optimum exposure time with each paper grade. Now you're ready to print: Place the exposure probe in the brightest part of the image (see facing page; lighted exposure scale is visible at right of projected image); open enlarger lens until needle moves to star position; move probe into darkest part of image; note paper grade and read off the exposure time.

# Computer

**Perfect color values** in a color print are achieved by use of the Colorval's color probe (below). At its top is a holder for chips of color filters. In its base is a tiny mirror surrounded by a neutral reference light. Projected color image comes straight down, through filters, into mirror. You look into the mirror, change and add filters until mirror image is same color as reference light. The filter combination that does this is the right one for your enlarger.





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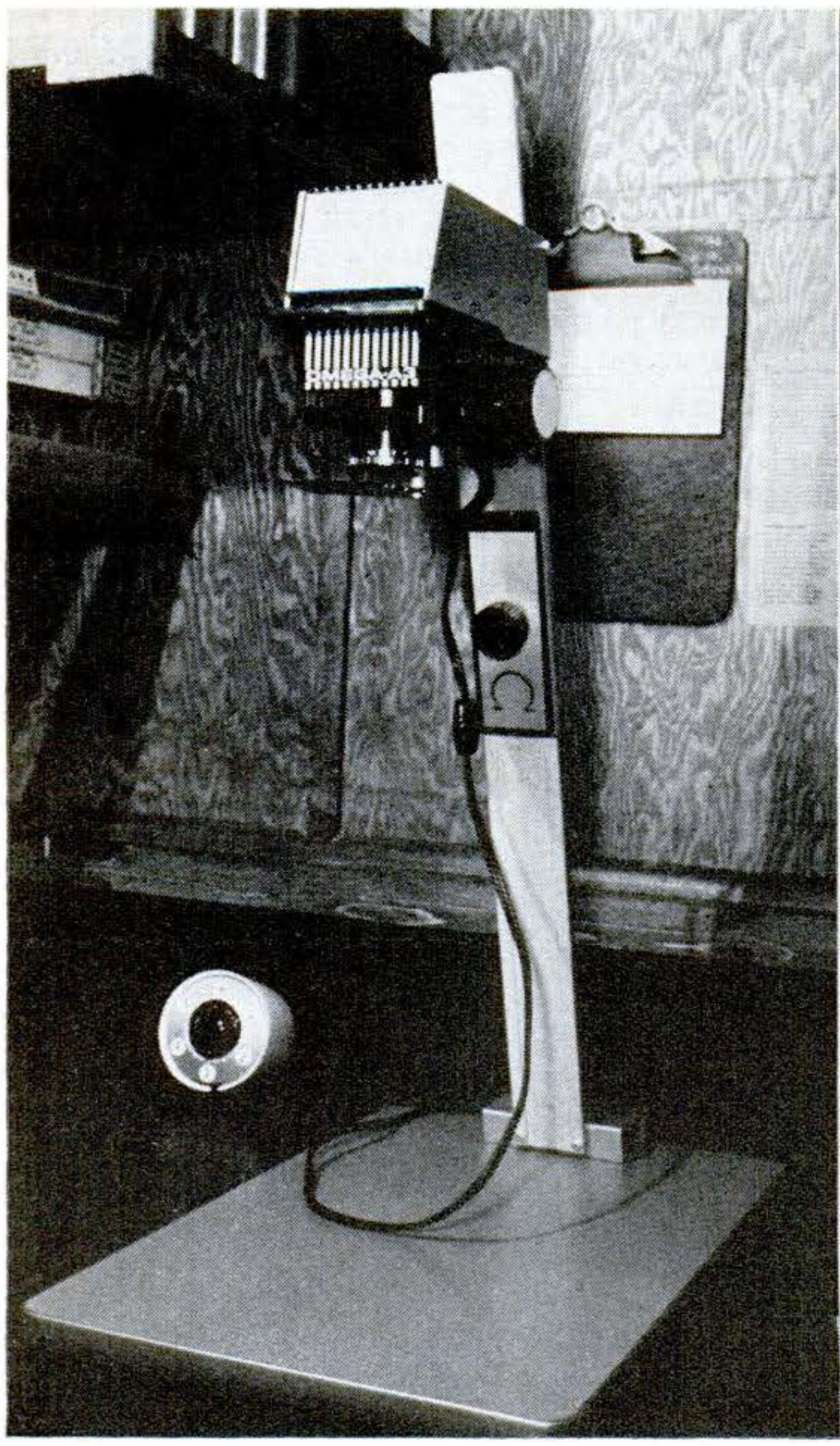
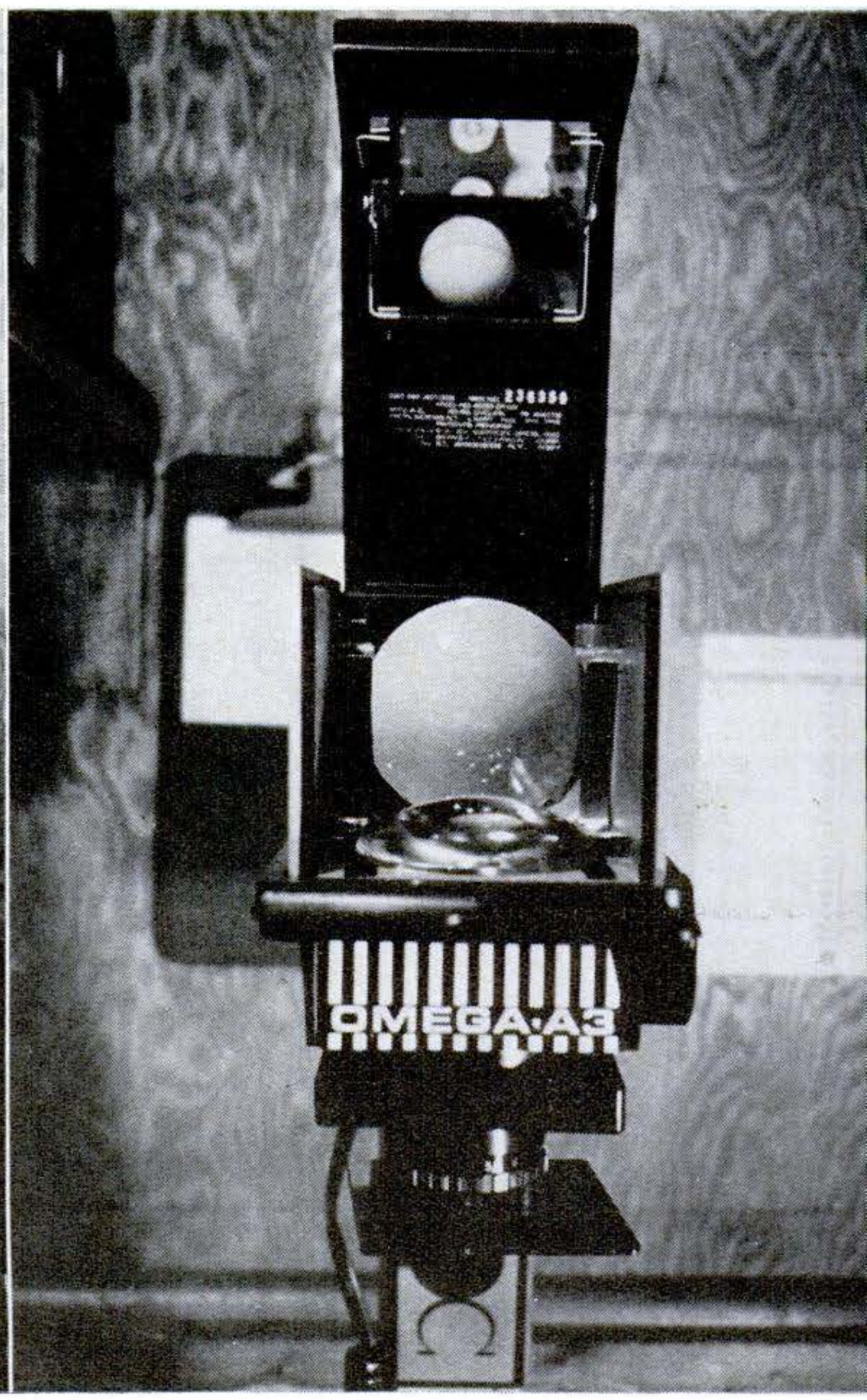
with your enlarger, you can make print after print without straying a photon from perfect exposure. Exposure time is constant for every paper grade. With the exposure probe placed under the thinnest portion of the negative, you open the enlarger diaphragm until the meter needle rests on a star printed on the scale.

For routine printing, this accuracy enables you to expose a number of prints in a row—all from different negatives—and then develop them all at once. With a dozen prints, you may decide to remake one.

Typically, in my experience, the remakes result from your disagreement with the Colorval's suggestion of paper contrast. The computer's advice is not based on art, but on measurement, and almost all prints come out with normal contrast. Fine. But what if you want *abnormal* contrast—stark blacks and whites side by side, or a soft, uncontrasty print? Then you must overrule the device.

Exposure for color follows the same procedure as for black-and-white. But the agony in making color prints lies not in exposing them but in choosing the right color filters for your enlarger. Heath's color probe enables you to select a combination of filters that will produce at least an adequate print on the first try, and probably a perfect print on the second. As developing color prints takes from 7½ minutes to an hour or more, the time saving over the old trial-and-error method can, if you figure your time in terms of money, easily pay for the $89 the Colorval costs (in kit form, $125 assembled). Heath, Benton Harbor, Mich.






**New Omega A3** features angled light path: Light travels horizontally from bulb through heat-absorbing glass and condenser to mirror, which bounces it down through second condenser and lens. Condensers are easy to get at and clean. Fins on top of lamp house dissipate heat and help keep enlarger cool.



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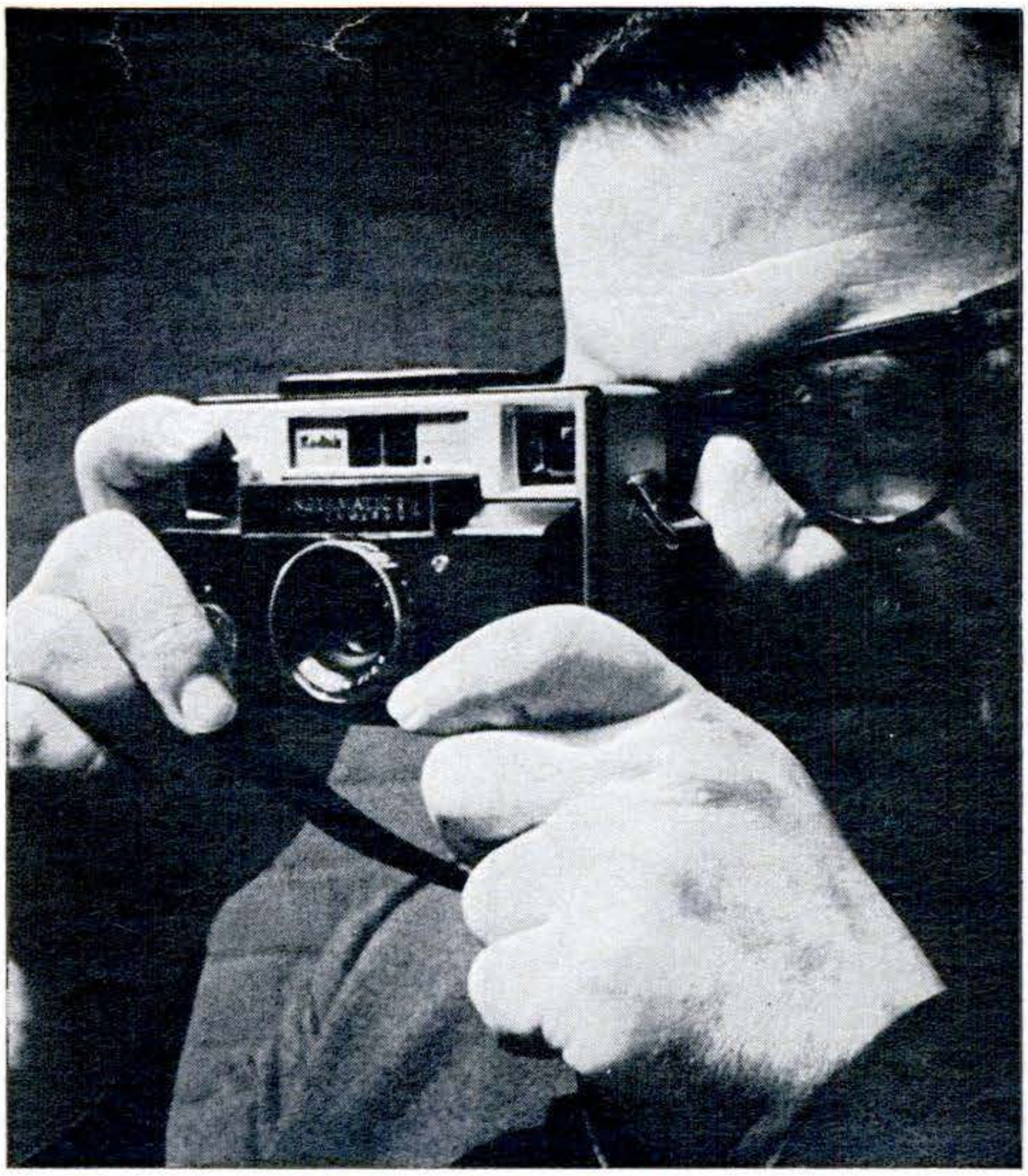
# KODAK 814



Try shooting a shot a second with a fancy $300 camera — especially with flash—and you'll discover one reason why motor-driven Instamatics are so popular. With their spring motor wound up, you can shoot off a 20-exposure cartridge in that many seconds. Two years ago [PS, Feb. '67], in a report on the predecessor to the new Kodak Instamatic 814, the 804, we asked: "How come this $125 camera outsells every 35 in the U.S.?"

The answer we got for the 804 goes in spades for the 814. The camera does almost everything itself. It takes over all the bothersome details of photography, freeing you to concentrate on subjects to make great pictures.

Exposure is automatic. You set the shutter-speed dial for 1/250, 1/125, or 1/60 second, and press the release. That's all. If the shutter speed is set too fast for the light, the speed is reduced automatically. If there's not enough light, USE FLASH appears in the viewfinder.

But the big news on the 814 is the lens: a four-element *f*/2.8 38mm Ektar.

I tested the $140 814 side by side against a 35mm camera that sells for about $30 more. The 814 beat the 35 in evenness and perfection of exposure. In lens sharpness, however, the 35 easily won the round. The 814 produced good pictures; the 35, excellent pictures.

All in all, however, for almost any amateur use, the 814 will prove a good and outstandingly reliable camera.

# OMEGA A3

Any photographer who has hungered for an Omega enlarger without having the bread to get one will be interested in the new $89.95 35mm Omega A3. But the big question is: Will it deliver Omega quality? The answer: It does, but . . .

The famous Omega cantilevered girder is there, but the famous Omega firmness is not. Example: When you lift your hand off the focusing knob, the plastic section under the lamp house shifts slightly, throwing the image out of focus.

Raising the enlarger head is a problem, too. You push it up or down on its track, secure it with a knob. But it tends not to want to move short distances, and when you give a harder push, over-rides the mark.

The lens, a 50mm *f*/4.5 Rodenstock, is excellent. Pictures were sharp all over. Projection brightness, however, was uneven. Using the Heath Colorval, I found that the upper portion of the image was a half-stop dimmer than the rest—probably due to slight mirror misalignment.

Color filters, in a holder in the lamp house, are easy to get at. But you have to buy larger ones and cut them to fit.

All in all, if the proof of an enlarger is the pictures, okay. Otherwise . . . PS



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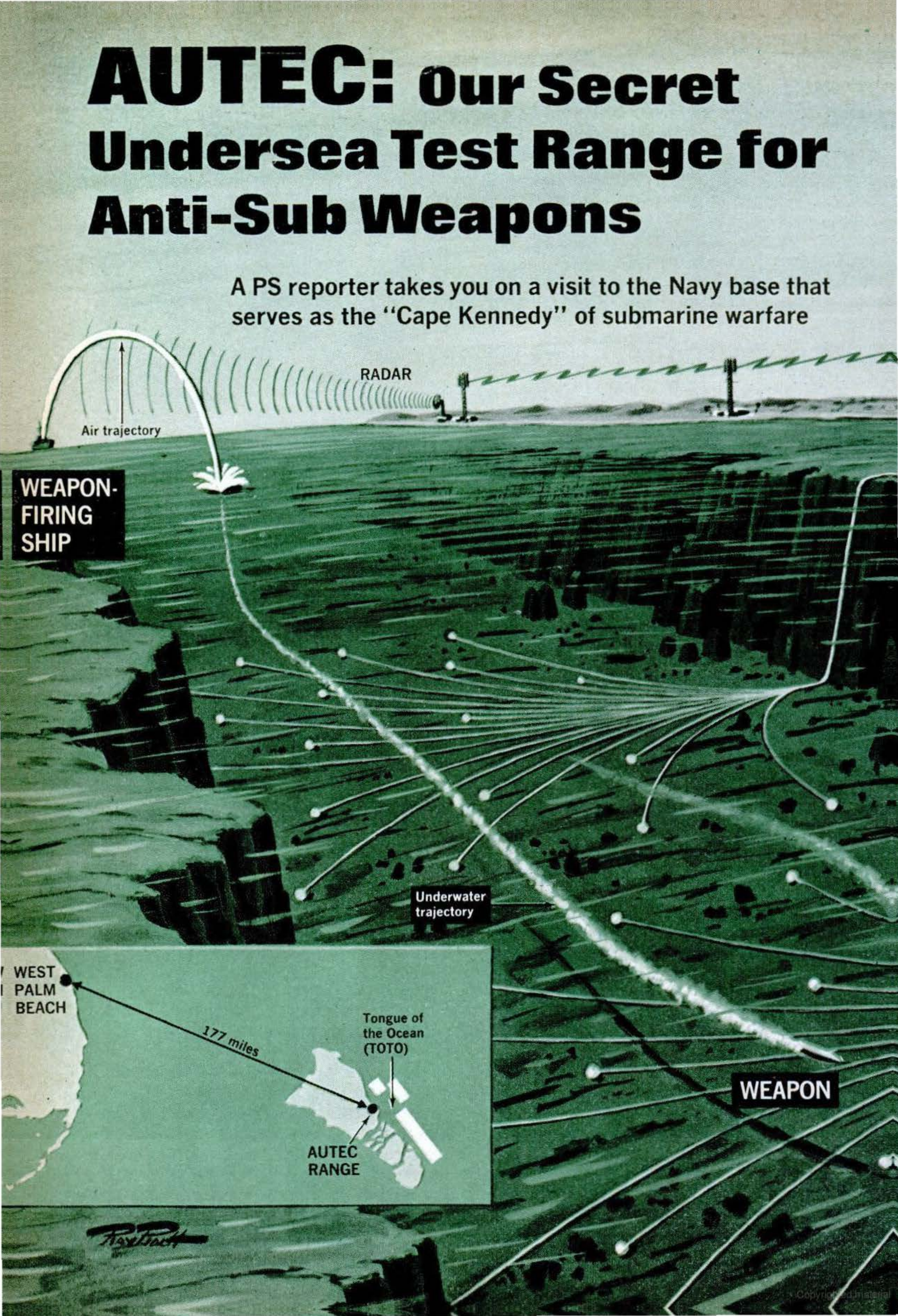
# AUTEC: Our Secret Undersea Test Range for Anti-Sub Weapons

A PS reporter takes you on a visit to the Navy base that serves as the "Cape Kennedy" of submarine warfare

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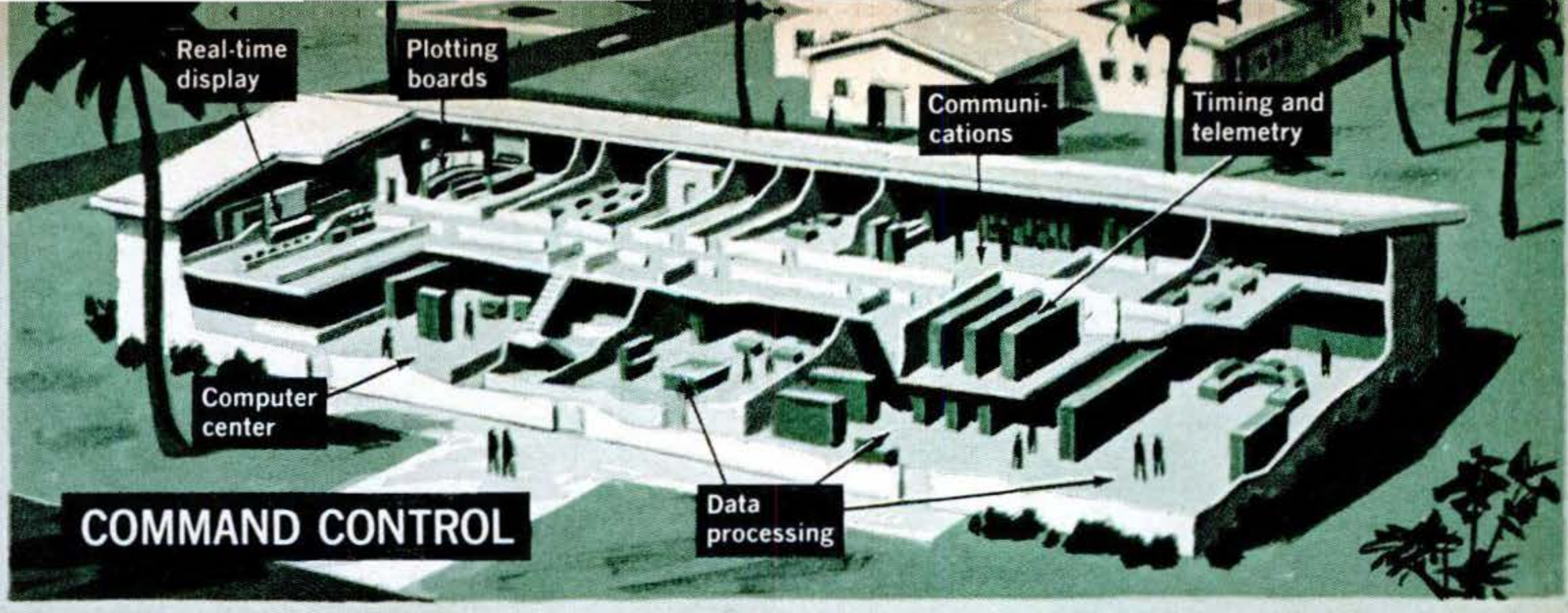
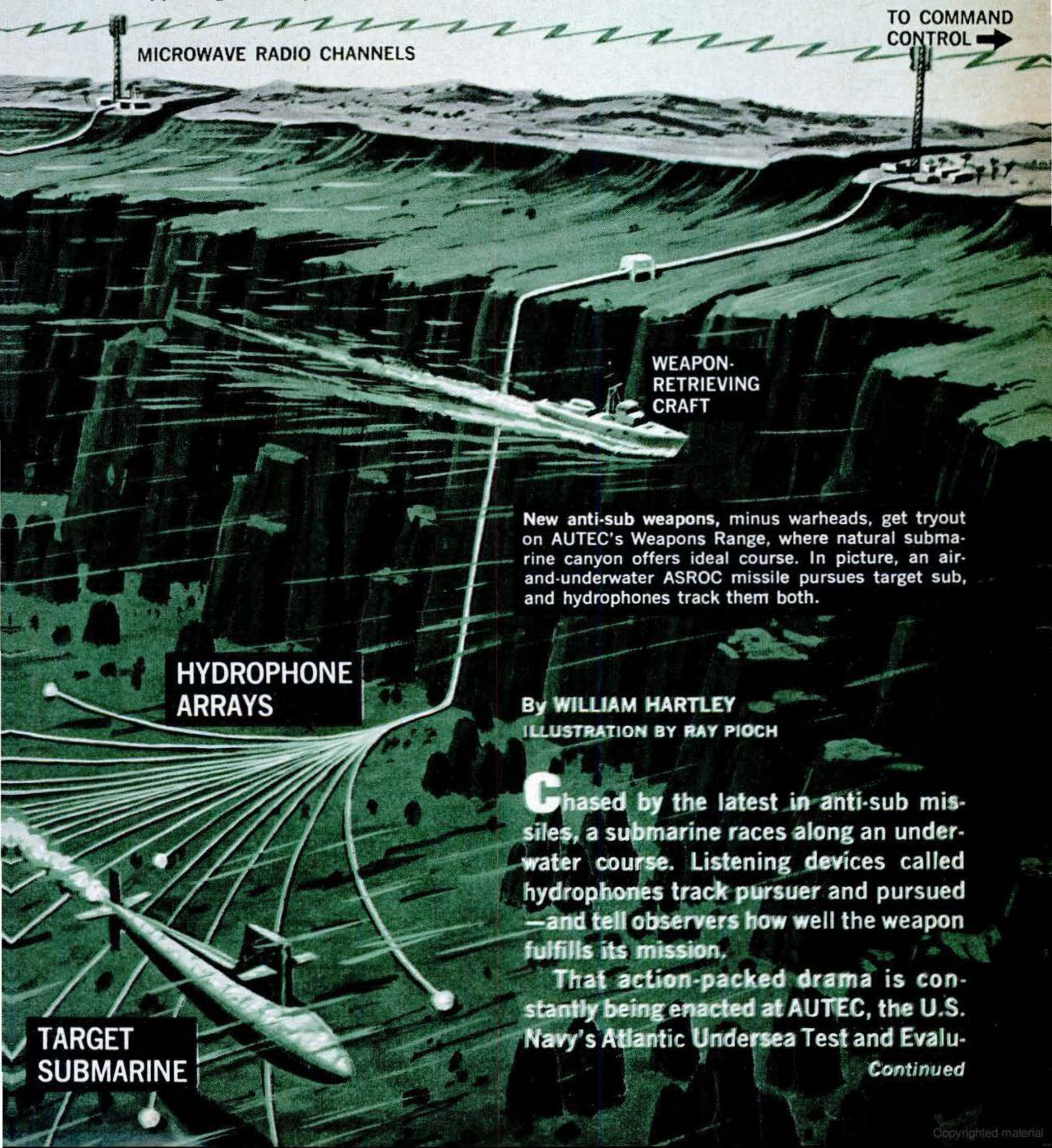



**What's happening on Weapons Range** is displayed and recorded in Command Control building.




**New anti-sub weapons,** minus warheads, get tryout on AUTEC's Weapons Range, where natural submarine canyon offers ideal course. In picture, an air-and-underwater ASROC missile pursues target sub, and hydrophones track them both.

By WILLIAM HARTLEY
ILLUSTRATION BY RAY PIOCH

Chased by the latest in anti-sub missiles, a submarine races along an underwater course. Listening devices called hydrophones track pursuer and pursued —and tell observers how well the weapon fulfills its mission.

That action-packed drama is constantly being enacted at AUTEC, the U.S. Navy's Atlantic Undersea Test and Evalu-

*Continued*

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# Weapons Range outposts track missile and target—and transmit data

**Site 4,** on islet, is one of 35-mile Weapons Range's chain of tracking stations along Andros coast. They stretch uprange from Site 1, main AUTEC installation and site of Command Control data center, to which they report their observations by microwave system during a weapon's test.

ation Center in the Bahamas. American lives, yours included, may hang on the outcome of the secret trials. For they play a vital part in countering the fast-growing threat of Soviet missile-launching submarines off our shores.

Times have changed since the Navy met its last big antisubmarine-warfare test for real. During its blockade of Cuba in the 1962 missile crisis, it spotted and tracked six conventional-powered submarines deployed by the U.S.S.R.—and, by being capable of destroying them if necessary, canceled their menace. But today Russia is building a fleet, at a phenomenal rate, of far-more-advanced nuclear subs—fast and formidable. Trying out the sophisticated new weapons needed to cope with them is where AUTEC comes in.

Commissioned just last year, AUTEC is the Navy's first center for testing antisubmarine-warfare systems as a whole. So far it has cost more than $150 million—with a Weapons Range in operation, an Acoustics Range being checked out, and a Sonar Range under construction.

## A made-to-order test site: TOTO

The Navy found an ideal site at Andros Island, largest of the Bahamas. Just off the eastern side lies a remarkable body of water known as the Tongue of the Ocean—TOTO for short. It's more than 100 miles long, 15 miles wide, as much as 6,600 feet deep. Its sides drop off sharply like those of a bathtub.

TOTO offers generous maneuvering room for surface ships, subs, and weapons. Deep water is close to land—important, since tracking stations and a data center need fixed land sites. The area is free from shipping. There are no violent currents, and few background noises to hamper acoustic work. Stormy weather is rare. If built to order, TOTO couldn't have suited the Navy better.

By agreement with the United Kingdom and the Bahamian government, the U.S. Navy has gained the use of the Andros site for 20 years. The Royal Navy will have equal access to all of the AUTEC facilities.

Trials of our supersecret new weapons' performance at AUTEC naturally are not for the public's eyes. Nevertheless a reporter can view the test equipment—and, from AUTEC informants' frank description of the weapons-testing trials, come back with a vivid picture of what happens there.

## A visit to AUTEC

Starting from Miami, I rose at 4 a.m., drove to AUTEC's U.S. base at West Palm Beach, and boarded the two-engine shuttle plane that carries AUTEC Navy and support personnel to and from the Bahamas site. Most of my 16 fellow-passengers were technicians for AUTEC's prime contractor, RCA. About 8:30, after bouncing through wind-torn clouds above the Gulf Stream, I was looking down on the water-splashed wilderness of Andros Island. We landed on a crushed-coral airstrip and jounced to a stop before a small customs building.

With an AUTEC escort, I banged over a tire-slashing coral road to Site 1, the main AUTEC installation. We drew up at the long low Administration Building, where a T-shaped flagpole flies U.S. and British flags side by side. After a briefing there, I toured Site 1.



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# Command Control

**Technicians** man consoles in control room of Command Control building, nerve center of AUTEC, to which Weapons Range's information-gathering network transmits all data. In a theater-like display center nearby, weapon-and-target chase can be viewed on screen "in real time"—while it's happening.

At this main site are the Command Control building, nerve center of the test ranges; a heliport; living quarters and a mess hall; and AUTEC's "navy" of small boats to recover torpedoes, and service sites. AUTEC's population is about 500 —seven Navy officers, some 40 enlisted men, plus civilians employed by RCA.

## Where the action is

Scene of the missile-chase dramas is the elaborately instrumented Weapons Range offshore. In a test, a ship fires an anti-sub weapon at a mobile target; the range's mission is to track both the weapon and the target, telling each one's position second by second.

The Weapons Range thus answers the questions: Where is the greyhound in relation to the rabbit? Gaining? Straying? If so, just when? The detailed and precise numerical answers gauge the missile's performance.

Largest of AUTEC's ranges, the Weapons Range is about 35 miles long, with most of its underwater instrumentation in a five-by-12½-mile area. Site 1 marks its downrange end. Tracking stations, called Sites 2 to 7, extend uprange along the Andros coast to the starting end of the Weapons Range. By microwave, during a trial, their observations pour into Command Control at Site 1.

In a small theater-like room I saw at Command Control, progress of a trial is usually displayed on a screen "in real time"—while it's happening. Tracking data also are stored for future use.

## Targets and weapons

Usually the target is a regular fleet submarine, manned by its usual crew. They may have a lively time of it. The sub may be told to take full evasive action, to see if a missile can follow it. Trial weapons carry no warheads, and are programed to cut off propulsion to avoid an actual hit, but there have been occasions when a target submarine has been grazed by a spent missile.

AUTEC has also experimented with a small unmanned target—a "submarine simulator," dropped from a helicopter, that takes off like a sub in the water. The one they tried was too slow. But they think that the Weapons Range will ultimately have to go to unmanned targets, with improved capabilities.

Weapons that AUTEC has tested include Mark 44 and Mark 46 torpedoes, and it is awaiting a newer Mark 48. Security-minded spokesmen don't discuss the latest weapons' details, but it's no secret that these torpedoes have come a long way from old-style "aimed" ones. Launched from subs, surface ships, or helicopters, they home on a target acoustically; they may be guided passively by its sound, actively by their own echo-locating system, or both.

AUTEC has worked too with DASH, ASROC, and SUBROC weapons systems. DASH, an unmanned helicopter, drops a submarine-seeking solid-fuel missile. ASROC, a surface-to-underwater rocket, delivers a homing torpedo or a nuclear depth charge near the target. SUBROC, submarine-launched and rocket-boosted, shoots out of the water and then dives back to pursue its target. The air route is quickest—and seconds may count, to destroy a hostile submarine about to launch a ballistic missile.

[Continued on page 210]



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Last Saturn V nears end of first-stage burn. Troubles began at this point.

# The Detective Story Behind OUR FIRST MANNED SATURN V SHOOT

**By solving the mystery of what went awry last time, engineers give the giant moon rocket a "go" to carry astronauts on the next Apollo mission**


**By DR. WERNHER VON BRAUN**

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.


SKETCHES BY THE AUTHOR

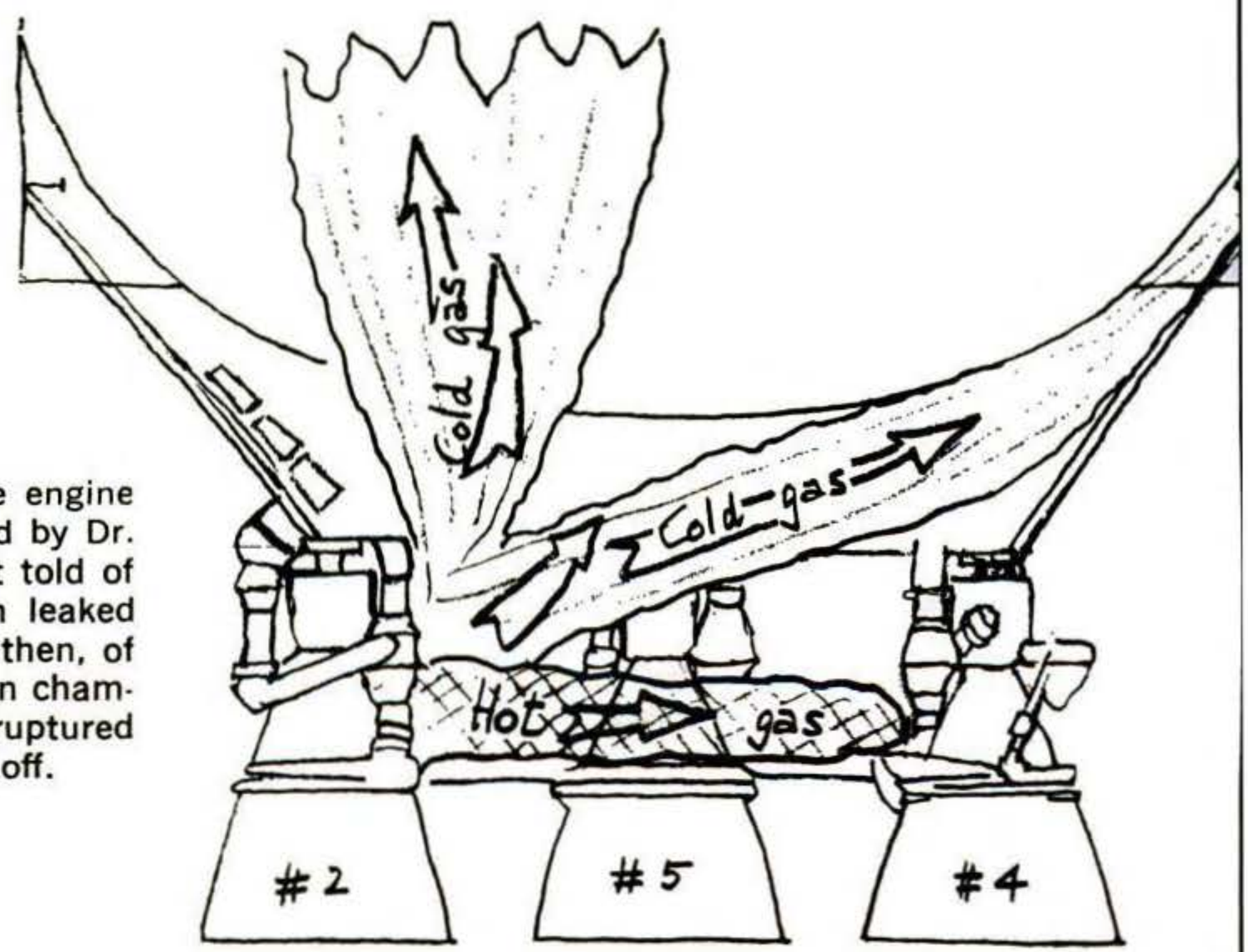
A few weeks hence, at Cape Kennedy, the first manned Saturn V will thunder aloft —our 363-foot-high moon rocket. A triumph of detective work has cleared the way for astronauts to ride it.

So far, just two of the giant rockets have been launched, both unmanned. The first Saturn V flight went off flawlessly late last year. A string of mishaps, in contrast, beset the second one last April. But the diagnosis of these has been so conclusive, and the remedies so successful, that the unmanned trial will not need to be repeated. NASA has decided to go right ahead and fly the third Saturn V manned.

The story of how the second Saturn V flight's troubles were identified resembles a detective thriller. It illustrates, too, modern methods of shaking down a complex space vehicle.

**The last flight.** The second Saturn V's takeoff at the Cape was faultless. For two minutes everything looked like a repeat of the first Saturn V's textbook performance. Then came a little excitement in the launch control center when, around the 125th second, telemetered signals from accelerometers indicated an apparently mild "Pogo" vibration.

This is a lengthwise oscillation, named after the motion of a Pogo stick, which had caused no little concern with the earlier Titan-boosted Geminis. It makes a space vehicle lengthen and shorten like a concertina, several times a second. But




**Clues to conking-out** of second-stage engine No. 2, on last Saturn V, are sketched by Dr. von Braun. Thermocouples on rocket told of flow of cold gas, as liquid hydrogen leaked from igniter fuel line and vaporized; then, of hot blast, as fire gas from combustion chamber spurted like blowtorch from ruptured line. Losing thrust, engine shut itself off.



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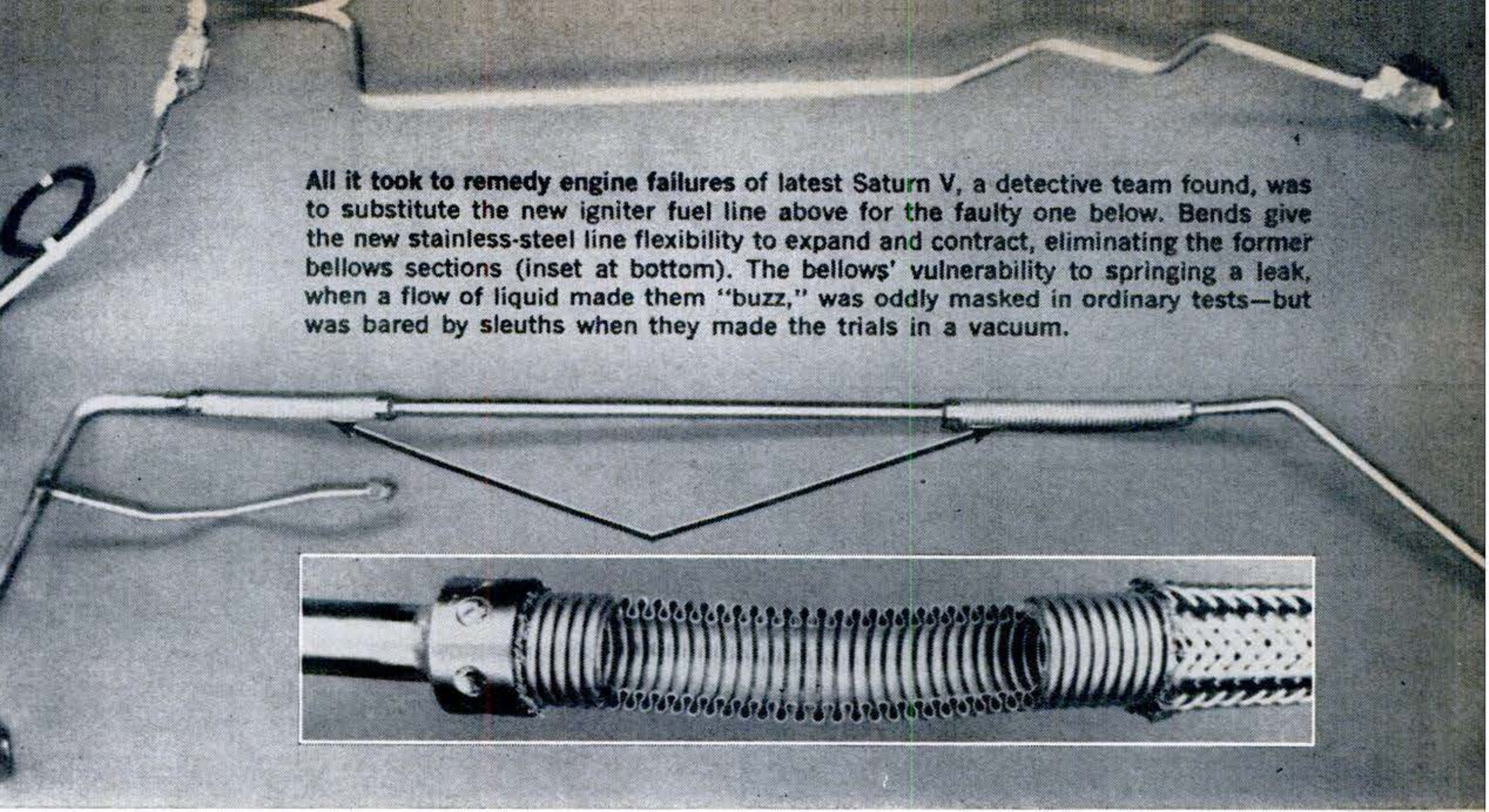

**All it took to remedy engine failures** of latest Saturn V, a detective team found, was to substitute the new igniter fuel line above for the faulty one below. Bends give the new stainless-steel line flexibility to expand and contract, eliminating the former bellows sections (inset at bottom). The bellows' vulnerability to springing a leak, when a flow of liquid made them "buzz," was oddly masked in ordinary tests—but was bared by sleuths when they made the trials in a vacuum.

the Pogo vibration disappeared at about the 132nd second.

The second stage's five J-2 engines, burning liquid hydrogen, ignited exactly on schedule. But engine No. 2 soon gave signs of trouble. After burning for almost 4½ minutes, it suddenly lost thrust, and its low-thrust detection switch turned it off completely. Engine No. 3—which had performed perfectly up to this point—shut itself down a second later.

Deprived of two-fifths of its million-pound thrust, the second stage bravely fought on upward—with the trouble-sensing guidance system altering the climb path to help—and labored overtime before dropping off. The third stage's single J-2 engine started, and the bird arrived in a somewhat off-normal but stable parking orbit. When it had circled the earth twice, a radio command to reignite the third stage was sent. But the J-2 engine failed to respond.

To get the most out of the rest of the flight, the Command and Service Module carried in the nose was commanded to separate from the disabled third stage. After two burns of the Service Module, the Command Module made its reentry and was successfully recovered.

Had the flight been manned, the astronauts would have returned safely. But the flight clearly left a lot to be desired. With three engines out, we just cannot go to the moon.

Despite the J-2's impressive reliability in tests, two of the engines had conked out in second-stage flight, and a third had balked in orbit. Why, suddenly, three failures on a single flight?

**Sleuths find clues.** A joint detective team of engineers from NASA's Marshall Space Flight Center and from Rocketdyne, the J-2's maker, went to work. Soon they discovered clues. Counting time from second-stage ignition, telemetered temperature readings of thermocouples in the second stage's tail told this story:

- At about the 70th second, a flow of cold gas was detected, which could come only from a liquid-hydrogen fuel leak. The flow pattern clearly located the leak in the upper part of engine No. 2.
- The cold flow seemed to be increasing from the 110th second on, the time when engine No. 2 began to falter.
- Between the 262nd and 263rd seconds, a sudden blast of very hot gas came from the same place—just a split second before engine No. 2 shut itself off.

This short hot blast before shutdown was the giveaway. Only the fuel line to the J-2's igniter could fail in just this way. (The igniter is a hydrogen-oxygen pilot flame that helps start the engine, and burns while it operates.)

A leaking igniter fuel line would spray the surrounding area with cold hydro-

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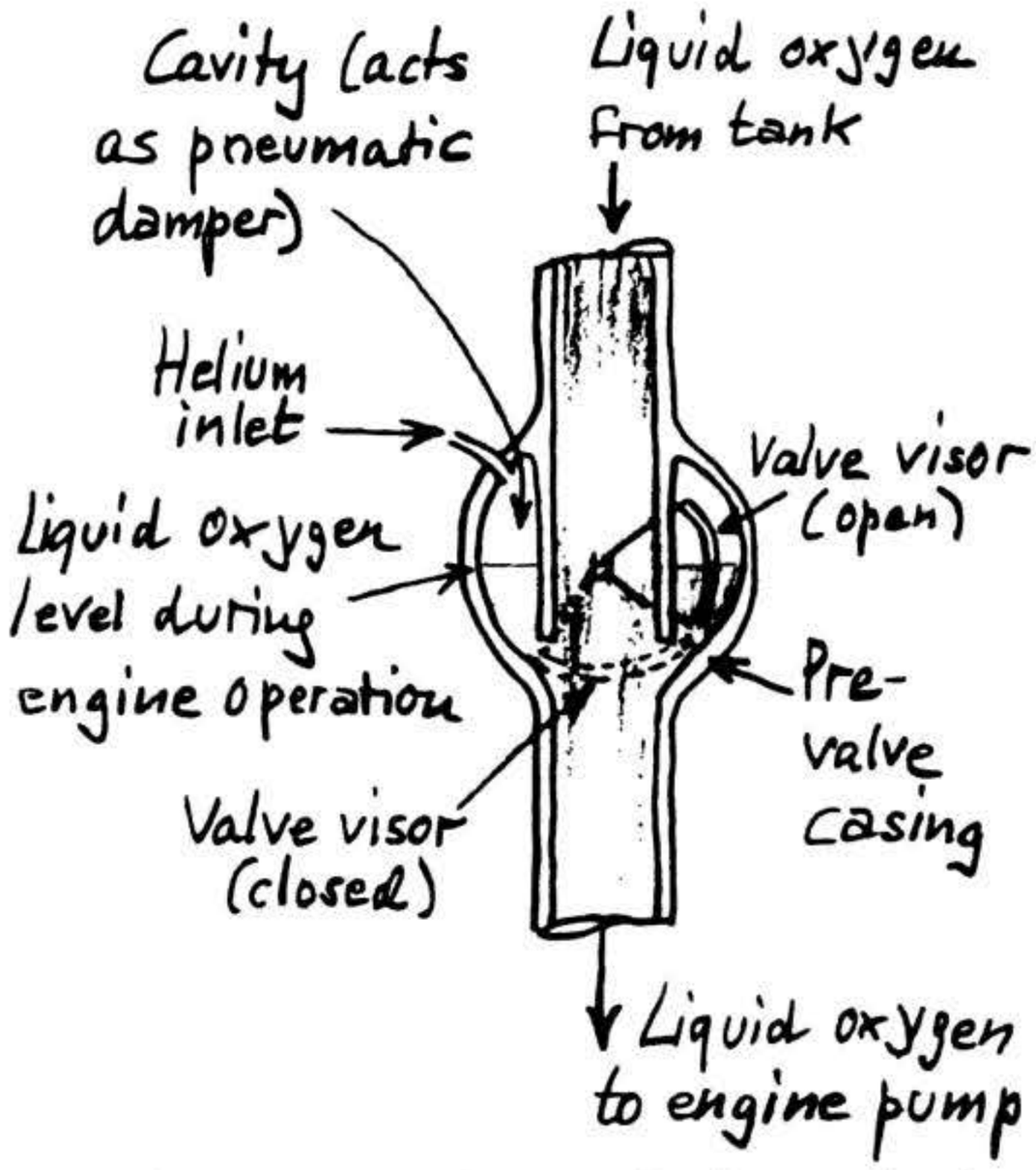


**Successful cure** for Saturn V's Pogo vibration, from slight pulsation in thrust of its mighty first stage, puts a shock-absorbing pneumatic damper of helium gas in each engine's oxygen prevalve.

gen, while it kept feeding some fuel into the igniter. But the moment the line failed completely, high-pressure fire gas from the rocket engine's combustion chamber would back up in it and rush out of the breach like a blowtorch, rapidly widening the uncooled opening. And when the engine's combustion pressure dropped below a certain point, the low-thrust sensing device would turn off the engine, by closing fuel and oxygen "prevalves" that control the propellants' flow to the engine pumps. That explained why engine No. 2 shut down.

But what made the healthy No. 3 engine quit an instant later? Embarrassingly, a plain human goof. Because of a mistake in wiring, the electrical signal intended to close engine No. 2's lox (liquid-oxygen) prevalve went instead to engine No. 3's prevalve. Thus engine No. 2, while it shut itself off by closing its own *fuel* supply, cut off engine No. 3's *lox* supply, too.

The third stage's J-2 engine shared the troubles of second-stage engine No. 2. During its first burn of 170 seconds there were the same telltale signs of leaking and rupture of the igniter fuel line, including the final hot blast. That put the engine out of commission – and so it could not be restarted.

**What ailed the igniter fuel lines?** Tortured in tests before, they went on the rack again. They proved immune to increased pressures and flow rates, and to a far more severe shaking up than in flight. Next came a study of resonant conditions: Did bellows sections in the lines, which provided flexibility for expansion, "buzz" at certain flow rates?

It turned out that they did—but it seemed impossible to make them fail as a result. Then eight lines were placed in a vacuum chamber. Liquid hydrogen flowed through them at the proper rate and pressure. Within 100 seconds, every line failed at the bellows section!

Movies made of bellows' tests solved the mystery. When the test chamber was *not* evacuated, surrounding air was liquefied by the extremely low temperature of the bellows (—350 to —400 F.) when liquid hydrogen flowed through it. The liquefied air, trapped by metal braid around the bellows, effectively damped its vibration at resonant points. Evacuate the chamber, and (as in space) the protective damping effect was gone.

Once this diagnosis of the engines' failures was made, the remedy was simple. New igniter fuel lines, with bends in the stainless-steel tubing for flexibility, eliminated the bellows sections—and that was all there was to it.

**Then, the Pogo fix.** The Marshall center set up a Pogo Task Force, too—supported by experts from other NASA centers, universities, and industry. The team studied the first-stage F-1 engines, made shake tests of parts of the Saturn V/Apollo structure, and reported:

Such is the nature of a rocket engine's operation that the F-1s' thrust and combustion chambers slightly pulsate, at a natural frequency of about 5½ cycles a second. The entire Saturn V with a spacecraft in its nose has a natural frequency, too, at which it is especially susceptible to longitudinal (concertina-like) vibration. Increasing as propellants are consumed, this frequency also approaches 5½ cycles a second at about 125 seconds after takeoff.

When the structure's responding frequency matches the engines' driving frequency, Pogo vibration can occur.

While not necessarily destructive, it un-

[Continued on page 209]



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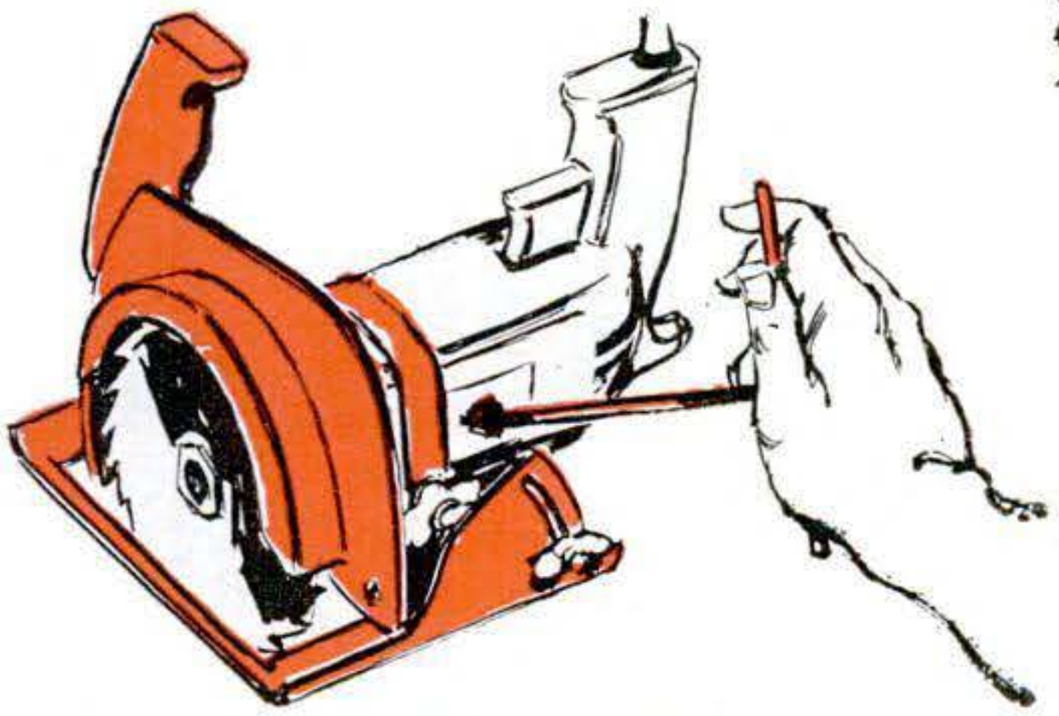
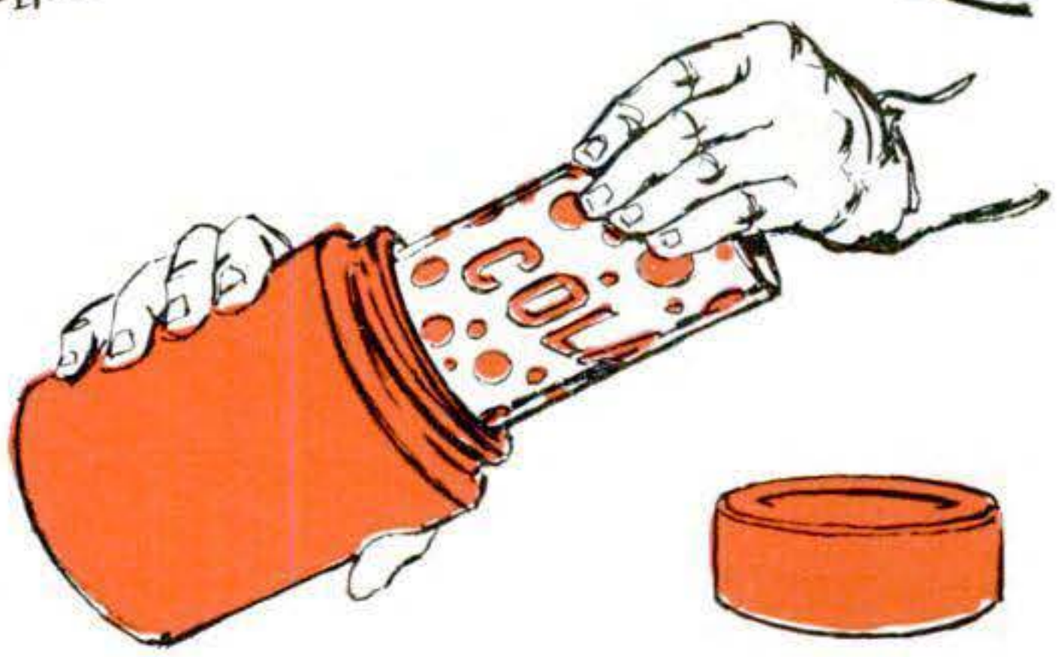
# "I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

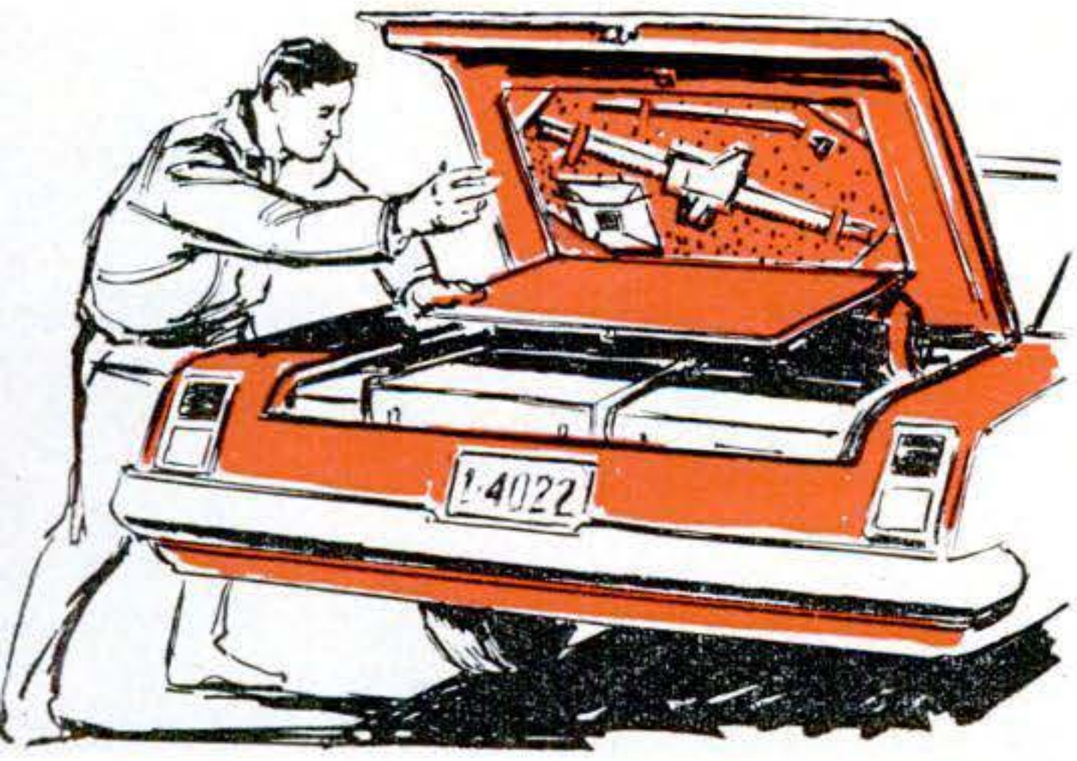
**Detachable skate blades** on shoes you'd wear to a pond, instead of freezing fingers and toes lacing and unlacing them.—*W. R. Waldron, Windsor, N. Y.*



**Long-reach chuck keys** that could make complete turns when drill is used with an accessory; a T handle for better leverage, safer tightening.—*Andrew Vena, Philadelphia.*



**An insulated container** just the right size to hold an unopened, but chilled beverage can. It would be handy for packed-lunch carriers. —*Michael Feese, Lake Ozark, Mo.*




**Built-in wells for jack storage** in auto trunk lids. Clips or snap-on straps could secure the jack, yet keep it handy in a full trunk.—*Larry Broaddus, Austin, Tex.*

**No-spill paint remover** packed in aerosol cans. A foam-type paint remover that you could just spray on and wipe off would be ideal.—*Fred Klink, Bucyrus, Ohio.*

*Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.*



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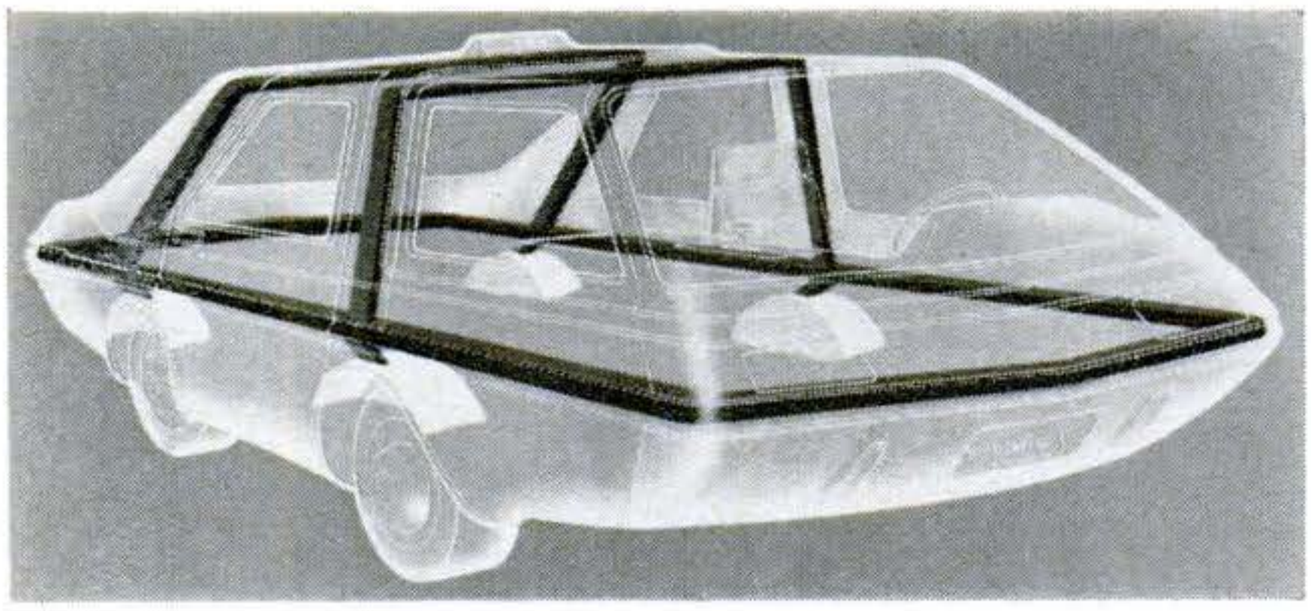
# We test-drive U.S. STEEL'S WAY-OUT TAXICAB



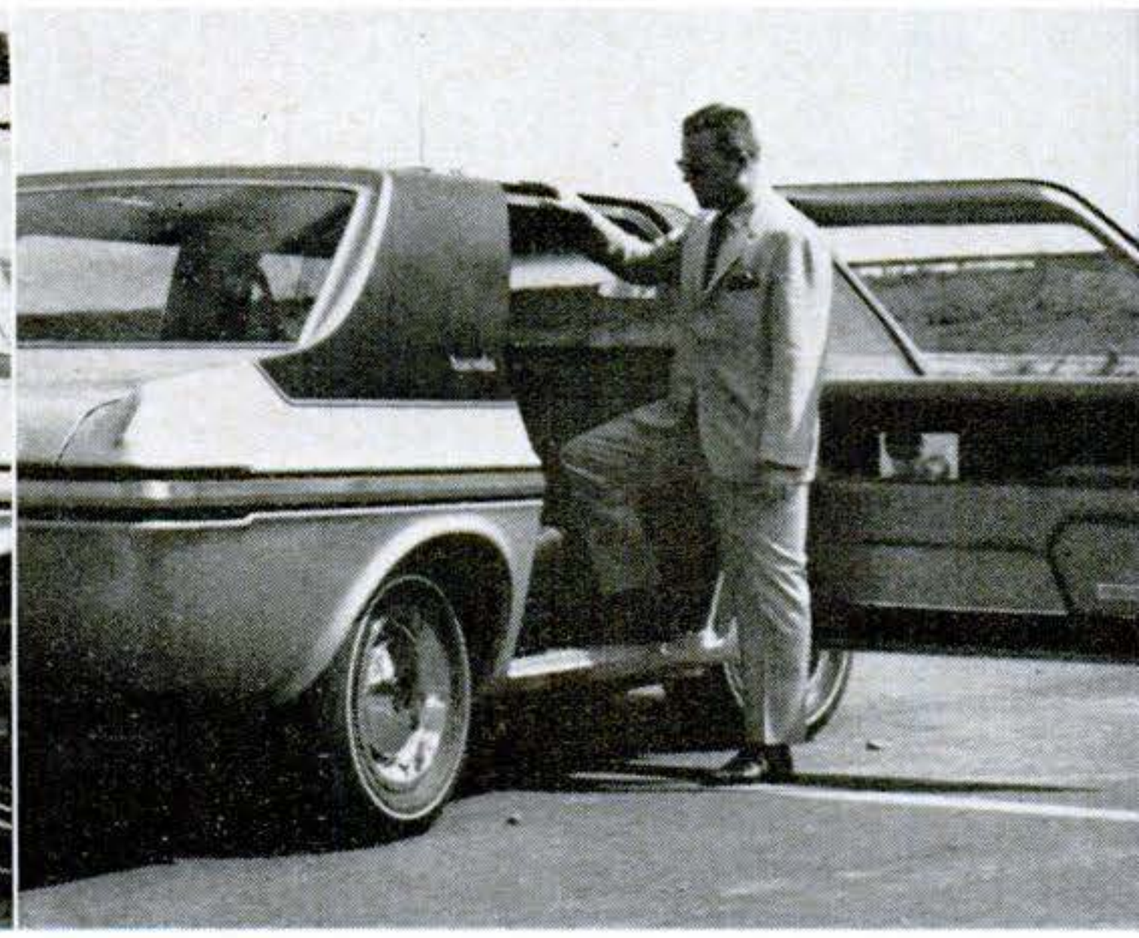
**Uniguard rails,** shown in phantom view above, are made of high-strength low-alloy steel. They run through doors and pillars. At right, Norbye tests turning circle of the cab.

**By JAN P. NORBYE** / *PS Automotive Editor*

How would you like to ride in a taxicab with doors over 47 inches high and 60 inches long? With 57 inches of leg room for the passengers and an almost flat floor? With a combined perimeter guardrail and rollover-bar structure for crash protection? I thought it would be great, and I was not disappointed when I walked inside and sat down. U.S. Steel built this cab to show its ideas to the auto industry, and reaction so far is very favorable.

When I drove the prototype, I found it had severe handling problems due to flaws in weight distribution. A good chassis engineer could fix it in a week, I

**In charge of the project** from the beginning was Mike Blew, seen in background above. He is telling PS about the design philosophy that went into car.



**Extra-large door** hangs on one hinge only, has roof cutout for easy entry, and swings open at right angles—all for the comfort of future taxi riders.



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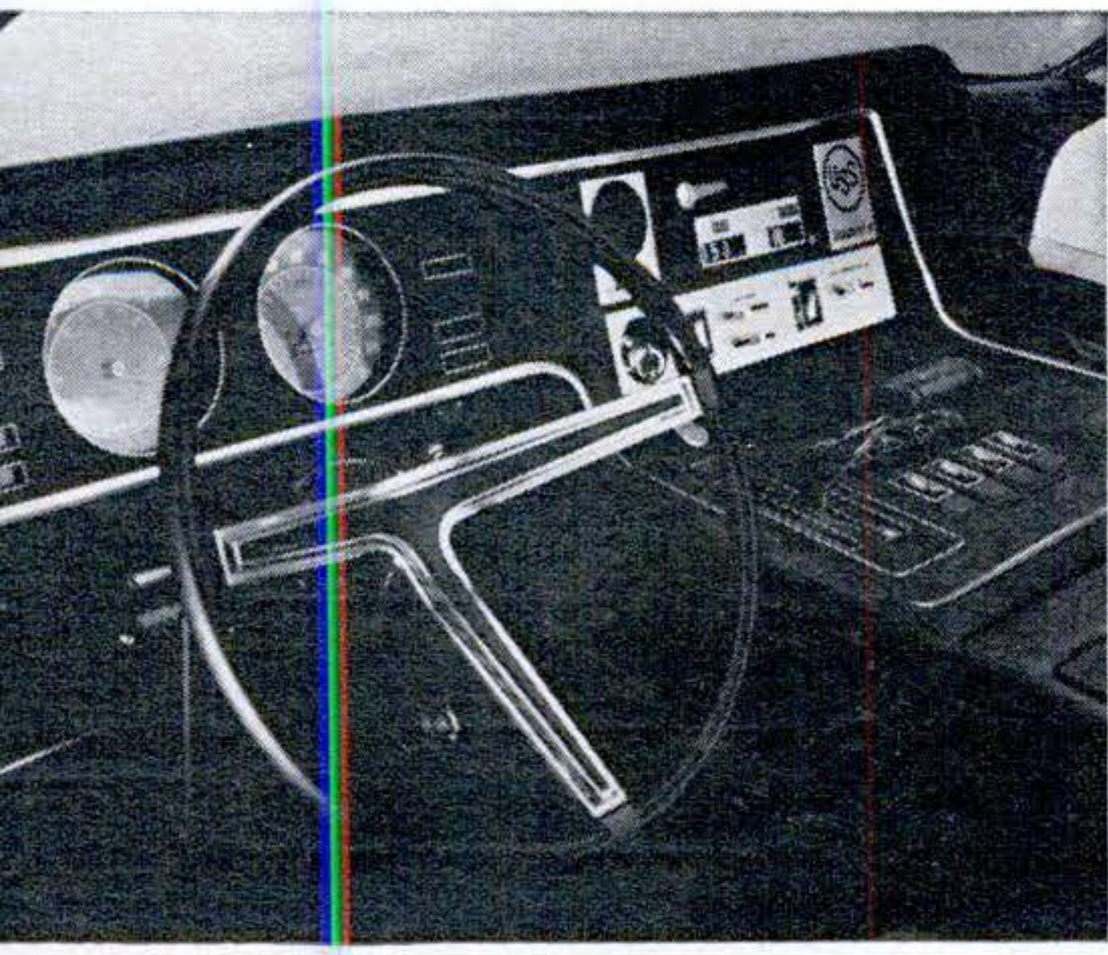
guess, but it would probably require changes in both wheelbase and engine position. However, the flaws in the chassis design do not detract from the convenience of the body design for taxicab use. It holds a lot of promise.

Since it's built from stock Chevy parts —engine, frame, suspension, etc.—Chevrolet has shown much interest in the prototype. U.S. Steel has also demonstrated it to Ford and Chrysler. I think it could lead to a cab version of the sportwagons [PS, May '67] in the future, probably with long-wheelbase options for airport limousine service or school-bus operation, or as a crew wagon or light delivery vehicle. Here it is, Detroit—now you've got the ball



**Engine of the experimental cab** is next to driver, who has all controls within easy reach. He commands overriding door locks for the passenger doors.

**Norbye** (in jump seat) turns on television set. The cab is air-conditioned. Rear-facing jump seats are illegal in some states, but are easily changed.



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# Build This Booster for Your Electric

## Add zip to your electric razor with this solid-state circuit. It's also a 220-volt converter

By RAY JACQUES

Is your five-o'clock shadow slipping back to four o'clock? Does your electric razor take longer than you would like to do a clean job? This easy-to-build booster can help by speeding up the motor in your electric razor. Also, with the flick of a switch on the unit, the booster serves as a converter so you can use the shaver on the higher voltages found abroad.

It works with the universal motor found in most modern electric-shaver designs. It won't work with the vibrator-type machines. So, if you're considering this booster as a project, make sure your shaver has a universal motor.

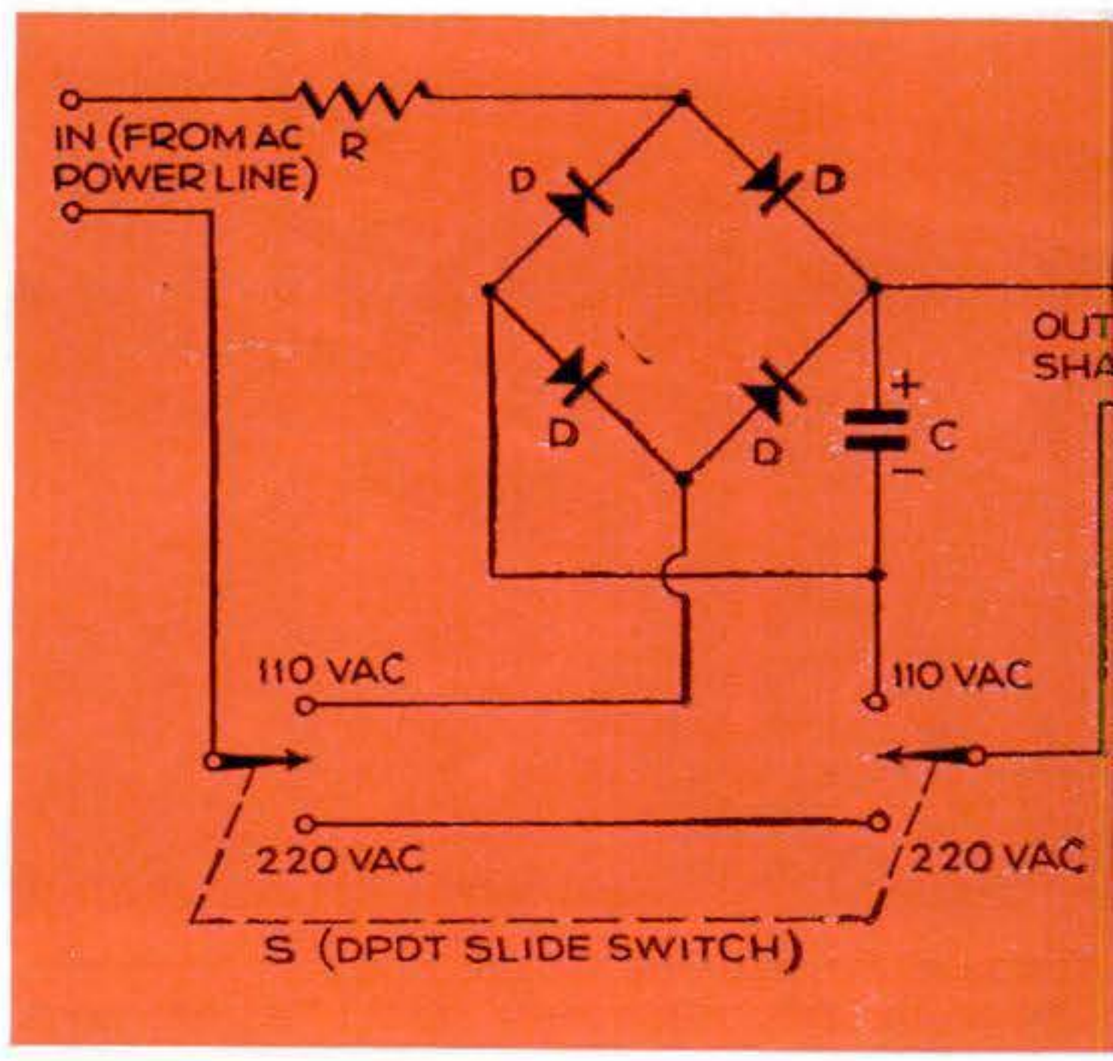
**How it works.** The circuit is based on the well-known bridge rectifier. It changes the AC voltage from your wall socket to pulsating DC. The output of the diode bridge rectifier charges a filter capacitor up to the peak voltage of the AC supply. The capacitor stores the voltage pulses to supply steady DC to the shaver motor. The effective voltage to your shaver is much higher than it gets when connected directly to your wall socket.

The motor windings also offer less impedance to the flow of DC than to AC, so the motor can develop a higher torque if needed. Because the shaver runs faster and cooler, it will require less service and last longer.

For 220-volt operation, the circuit is changed to a half-wave rectifier arrangement by switching three of the four diodes out of the circuit—and thus cutting output voltage to the shaver in half. So you can use your razor on any of the 220-240-volt power lines in foreign countries. And if you should meet up with 50-cycle power while abroad, the booster will help there, too. Its higher voltage compensates for 50-cycle losses.

The booster is simple and compact. It uses only seven small components—four diodes, a resistor, capacitor, and switch. These are assembled in a minibox together with male and female sockets for easy adaptation to wall socket and shaver-cord plug. Although other diodes will probably work, I recommend the ones specified in the parts list because they are specially designed for built-in protection against the transient voltages always present in the operation of a universal motor.

I've been using this booster for some time now and I've been getting faster and cleaner shaves than before. It also stands ready to go into my suitcase for use as a 220-volt adapter for that trip to Europe I'll be taking some day—soon, I hope.



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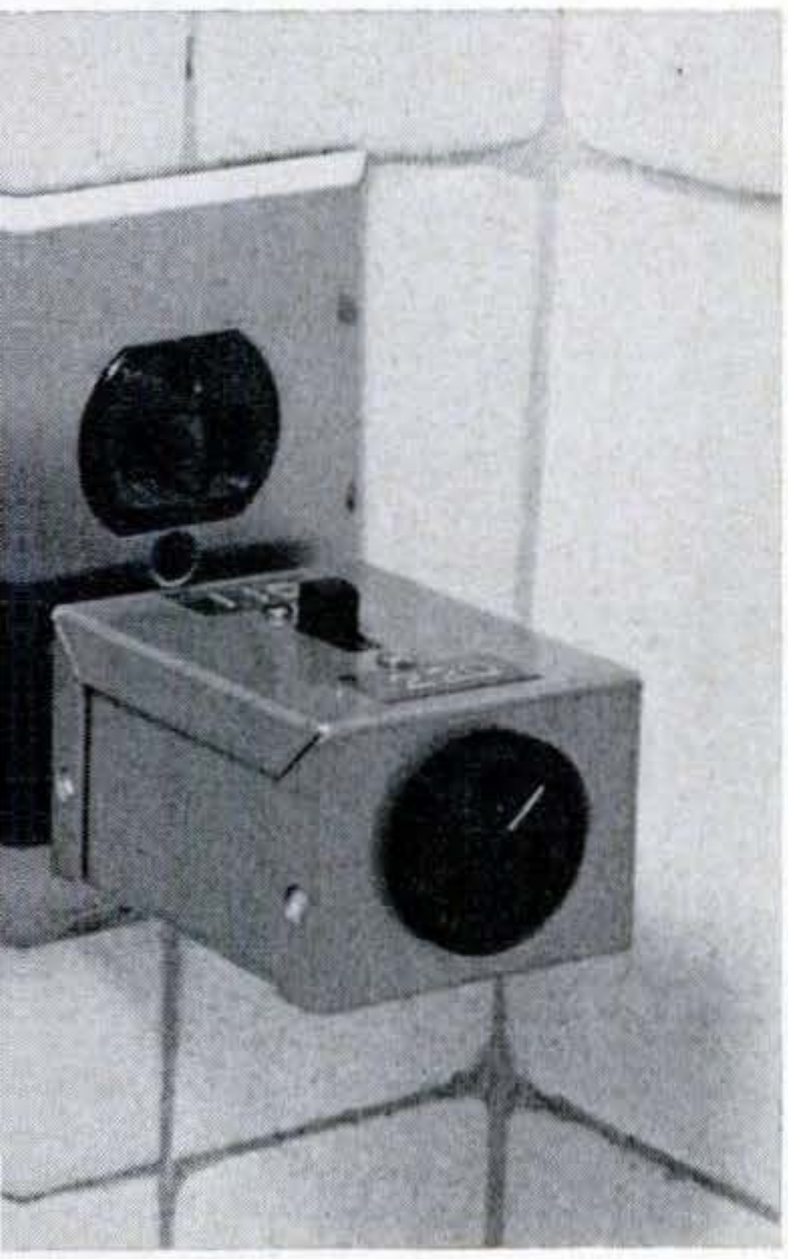
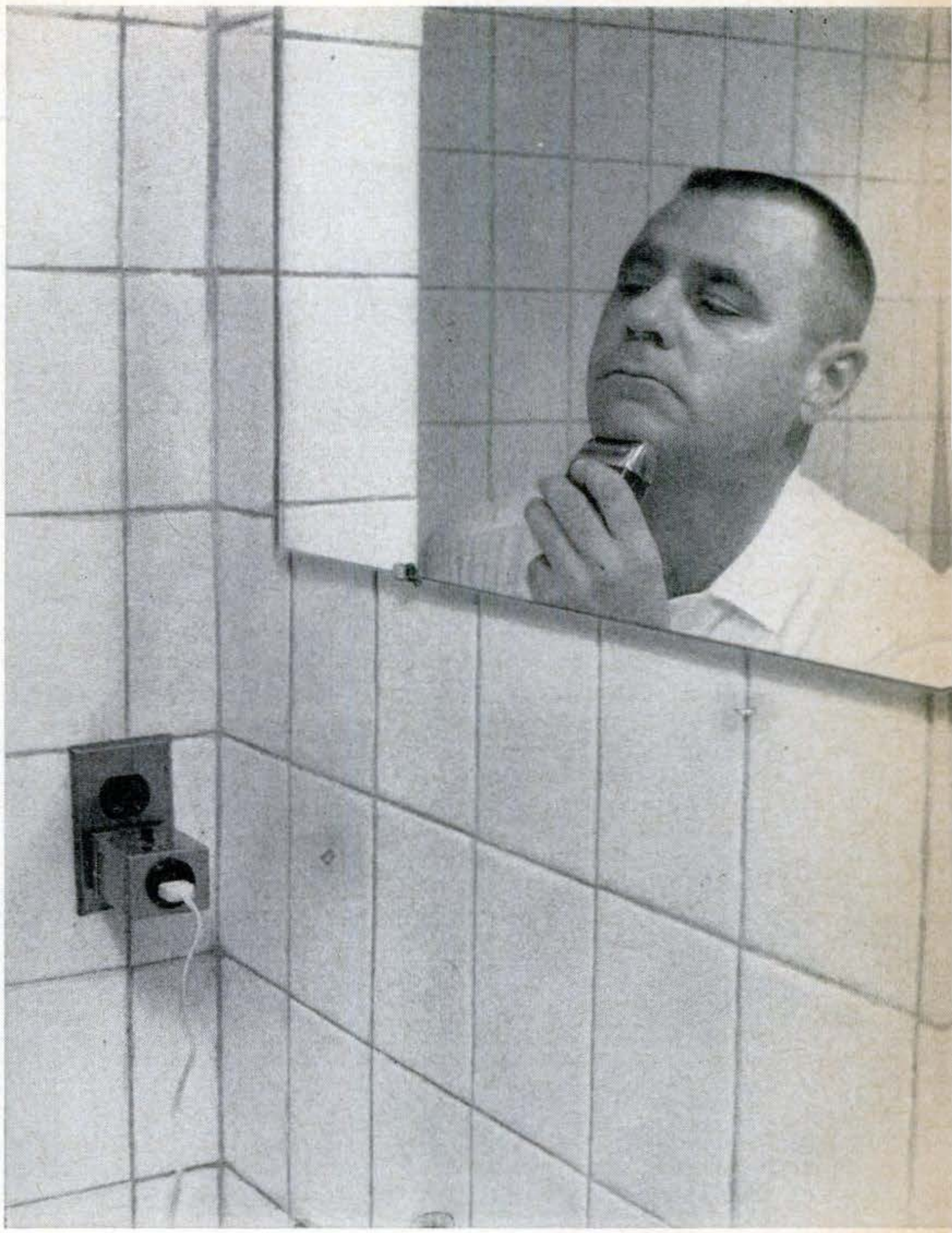
# Shaver

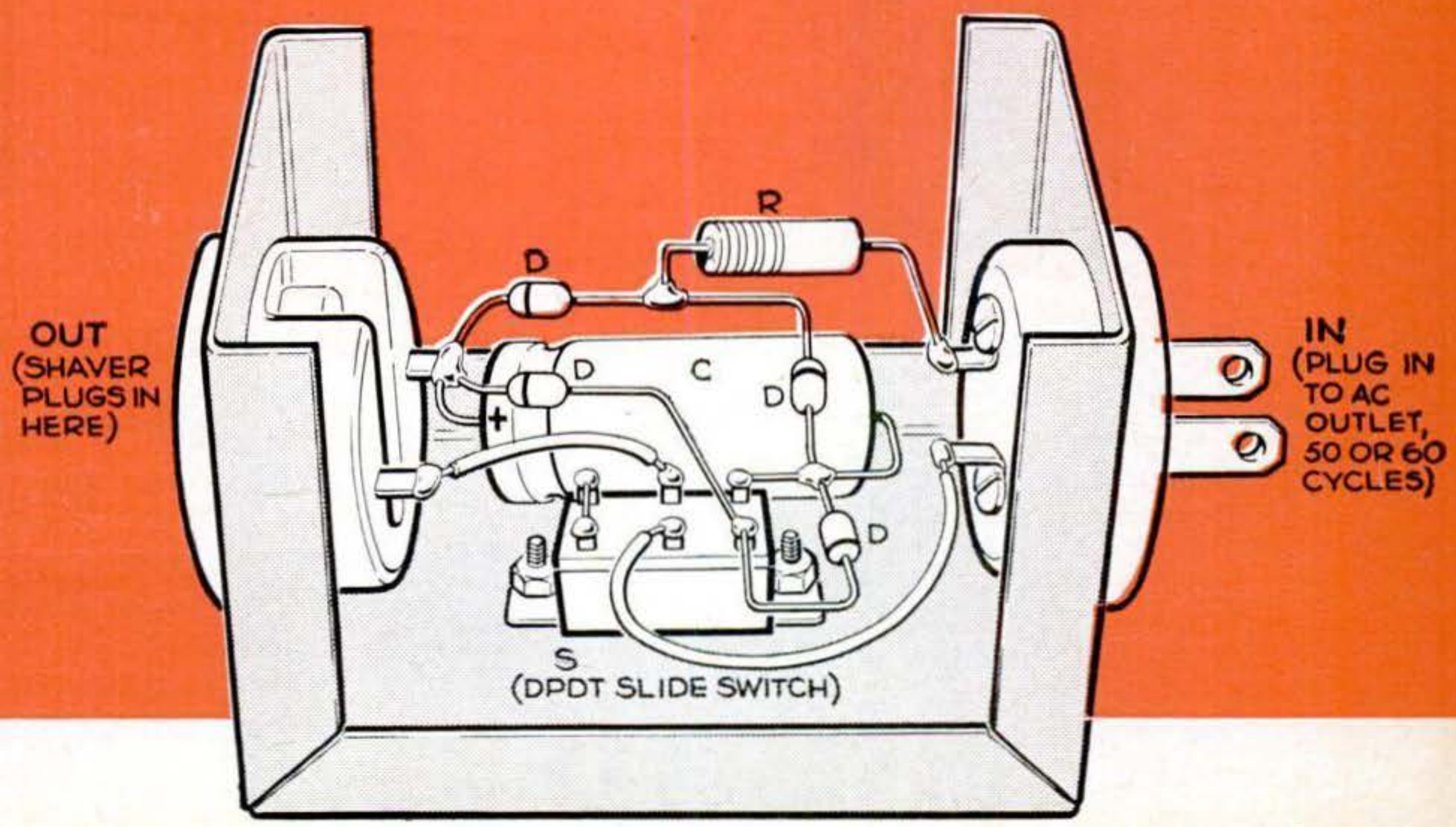


**ooster** plugs into wall socket for ›eed-up of electric shaver. It also oubles as a 220- to 110-volt con- erter allowing you to use your lectric razor when you are travel- g in foreign countries.



## ARTS LIST

*—1 ohm, 2 watt, wire-wound resistor*
*—10 mfd., 200-volt electrolytic capacitor*
*0—1N5059 (GE), Allied Radio 49R3-1N5059-GE*
*—DPDT slide switch*
*lox—Bud CU-2100A, Allied Radio 42B7616*
*lug—Amphenol 61-M*
*ocket—Amphenol 61-F*

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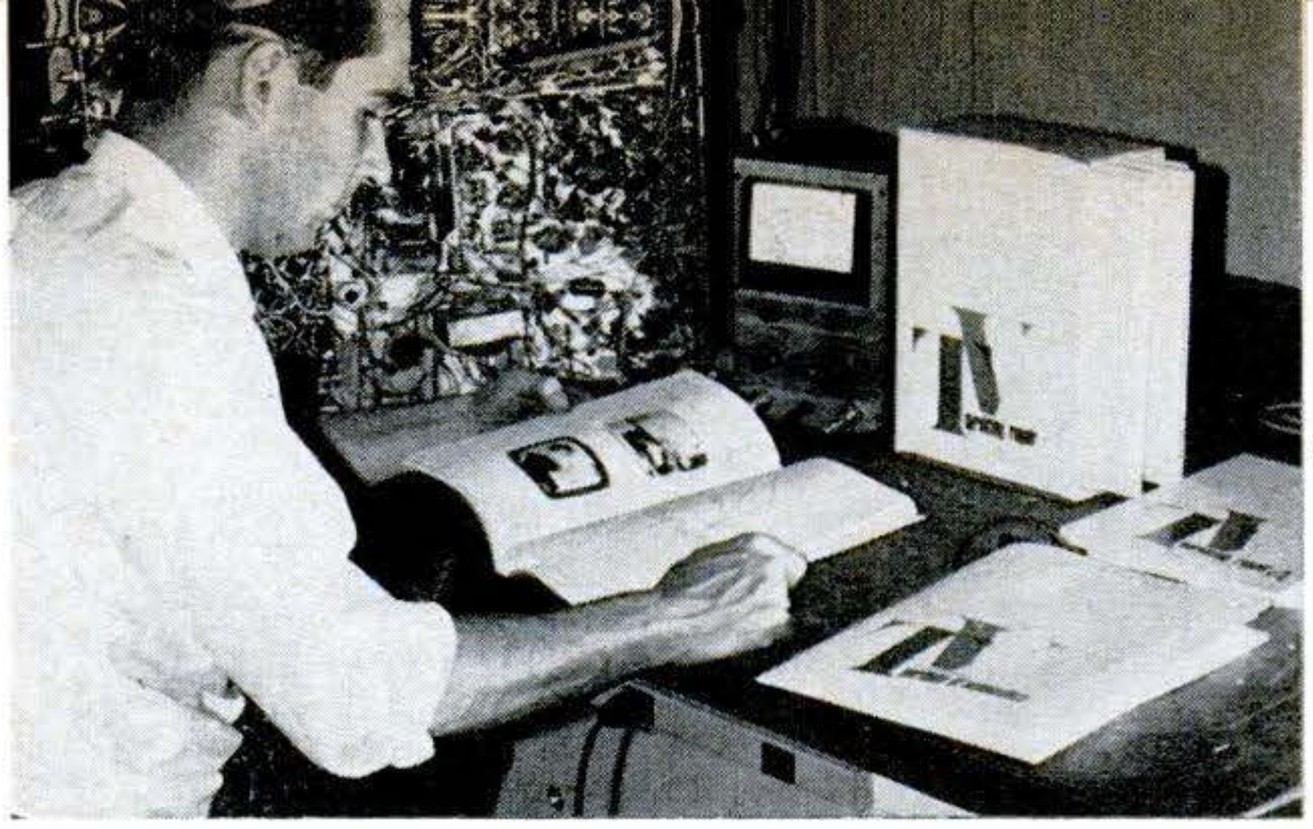
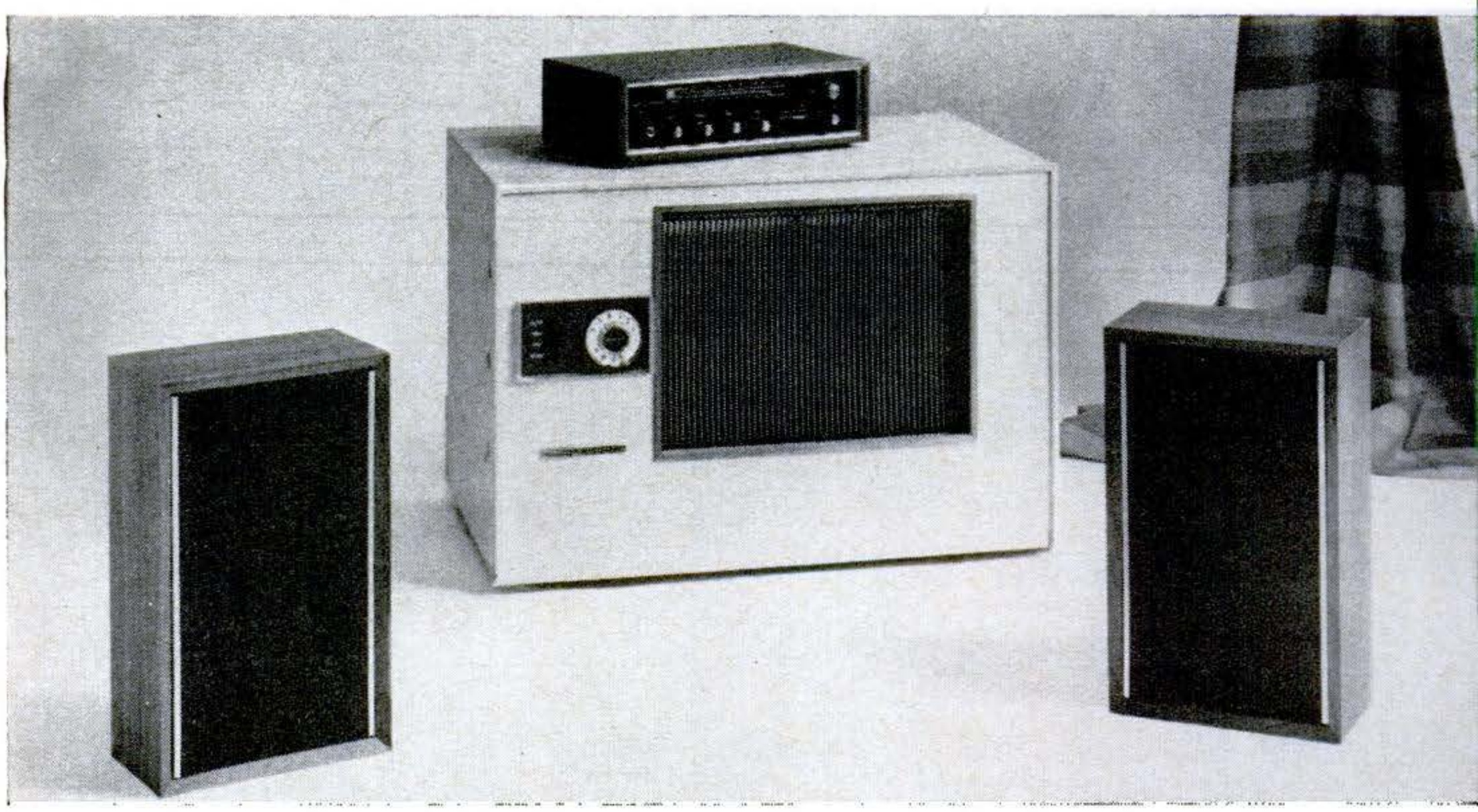


## TV repair course can make you a pro

Here's a way to beat those high TV-repair bills: Learn to service your set yourself. This new six-text course teaches you at home. In six months, it takes you all the way from tube changing to bench servicing of all TV-set disorders. No experience is necessary. Cost is $99 from International Correspondence Schools, Scranton, Pa. 18515.

### Wireless broadcaster plays musical instruments via FM

You can play your electric guitar, accordion, or other instrument through your FM set with this little radio-transmitting unit. Plugged into instrument output, the ⅝-inch-diameter unit has a 50-foot range. It's $14.95, with miniature antenna and tuning control. Saxton Products Inc., Congers, N. Y. 10920.



## Computerized home music system stores and plays 100 selections

You can dial your records as you would a telephone call with this automated record-playing system. Up to 50 LP records in its storage compartment are ready for computer-controlled call on dialing of two numbers System shown, in unfinished cabinet, include AM/FM tuner and speakers. $895. Seebur Corp., 1500 N. Dayton St., Chicago 60622

**TO REMOVE SECTION for loose-leaf binding, open magazine wid at this page, rest it on table, run your thumb firmly along center fold Then pull out the sheets gently, one at a time**



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PS EXTRA! 16-PAGE SPECIAL REPORT

# Antifreeze for Your Car

By RICHARD C. SICKLER

What is the best antifreeze for your car?
Why does your car need antifreeze in the summer?
What maintenance does your cooling system need?
When should you drain and replace your antifreeze?
When is a coolant not a coolant?
What happens when your engine is overcooled?

For the authoritative answers to these vital questions about one of your biggest auto-upkeep costs, plus many surprising facts about the cooling system in a modern car, turn the page.

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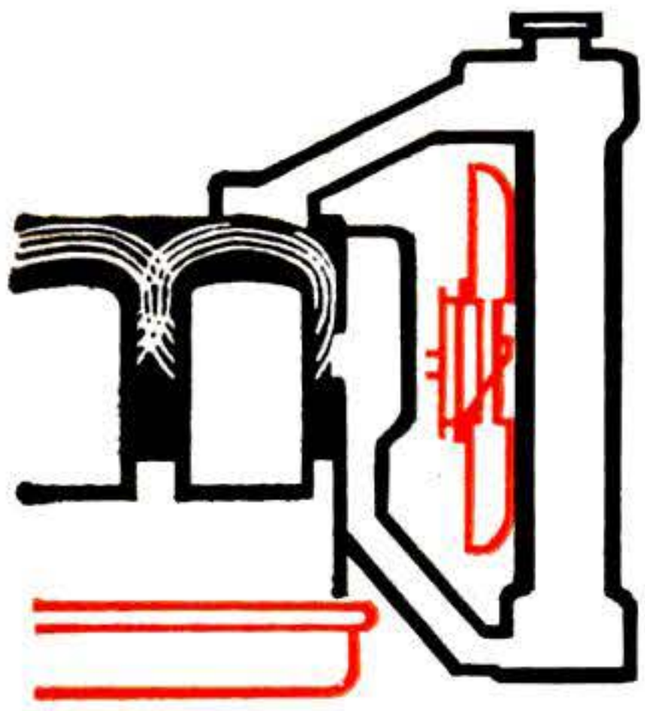
**PS Extra: ANTIFREEZE**



## ABSORPTION

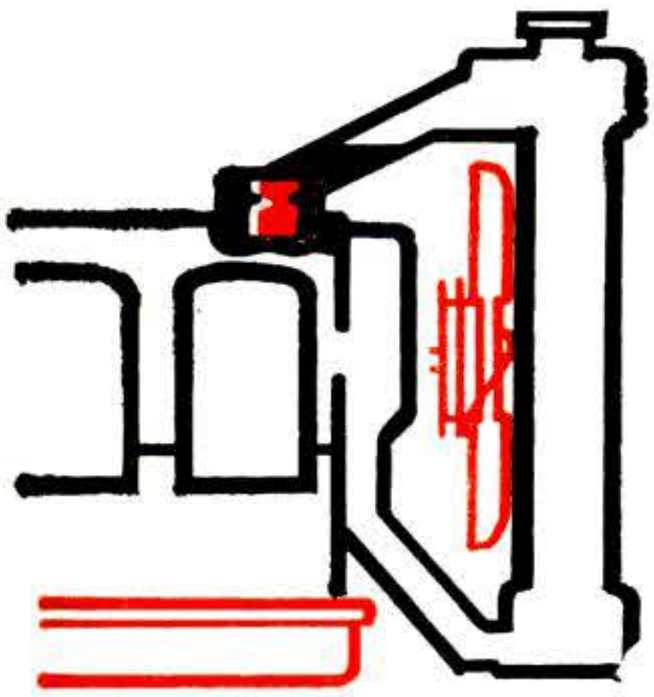
**Coolant** takes waste heat away from the engine, where combustion is taking place.

## CIRCULATION

**Waste heat** is carried by coolant from the engine to the radiator. The water pump assures rapid circulation.

## RADIATION

**Air flow** through the radiator removes the heat from the coolant and throws it off into the atmosphere.



## CONTROL

**Operating temperature** of engine is controlled by a thermostat that opens or closes off the coolant flow.

Your car engine runs best when it runs warm, and yet it needs a cooling system. Do you sometimes wonder why? Have you ever tried to figure out the amount of heat energy your 300-cubic-inch engine must develop to move your 4,000-pound car down the highway at 60 m.p.h.? It's close to 500,000 BTU/hour. And it's all produced by combustion of the gasoline.

Like all heat engines, the gasoline-driven piston engine is quite wasteful of the heat energy supplied to it [see "Gas for Your Car," PS June]. Only about a third of the fuel's heat energy is utilized as power. Half the waste heat escapes through the exhaust system; the other half is rejected through the cooling system.

Tests show that in hard driving conditions, today's big engines produce enough heat to melt an average 200-pound engine block in 20 minutes. Combustion temperatures reach 4,500 degrees F. Exhaust-valve heads can get red-hot, and lubricated parts such as pistons may be 200 degrees hotter than the boiling point of water. In normal highway driving, the cooling system must absorb and dissipate close to 150,000 BTU/hour to keep the engine running at its ideal temperature.

If your engine gets too hot, you're in for trouble—and plenty of it: burned or scorched pistons, sticking piston rings, warped or burned valves, lubrication breakdown, pre-ignition and knock, plus damage to the cooling system itself.

The cooling system and the antifreeze/coolant you use play vital roles in keeping your car running. Don't downgrade their importance and don't be casual about taking care of them.

# Keeping a Car's Cool

You can have trouble-free, year-round driving by thoroughly checking out all possible trouble spots—and immediately repairing any defects. But before you tackle the job, you should understand how your cooling system works and what it does.

The cooling system is designed to control the temperature of metals and other materials used in the engine—and do it within close limits regardless of driving conditions or outside temperature. It also has the job of letting the engine reach its normal operating temperature fast.

The cooling system consists of the main and heater radiators, pressure cap, hoses, water pump, cooling fan, thermostat, and passages or jackets for coolant circulation throughout the engine. When the engine is operating, the pump draws the cool liquid from the radiator and pushes it through the engine water jackets and back to the

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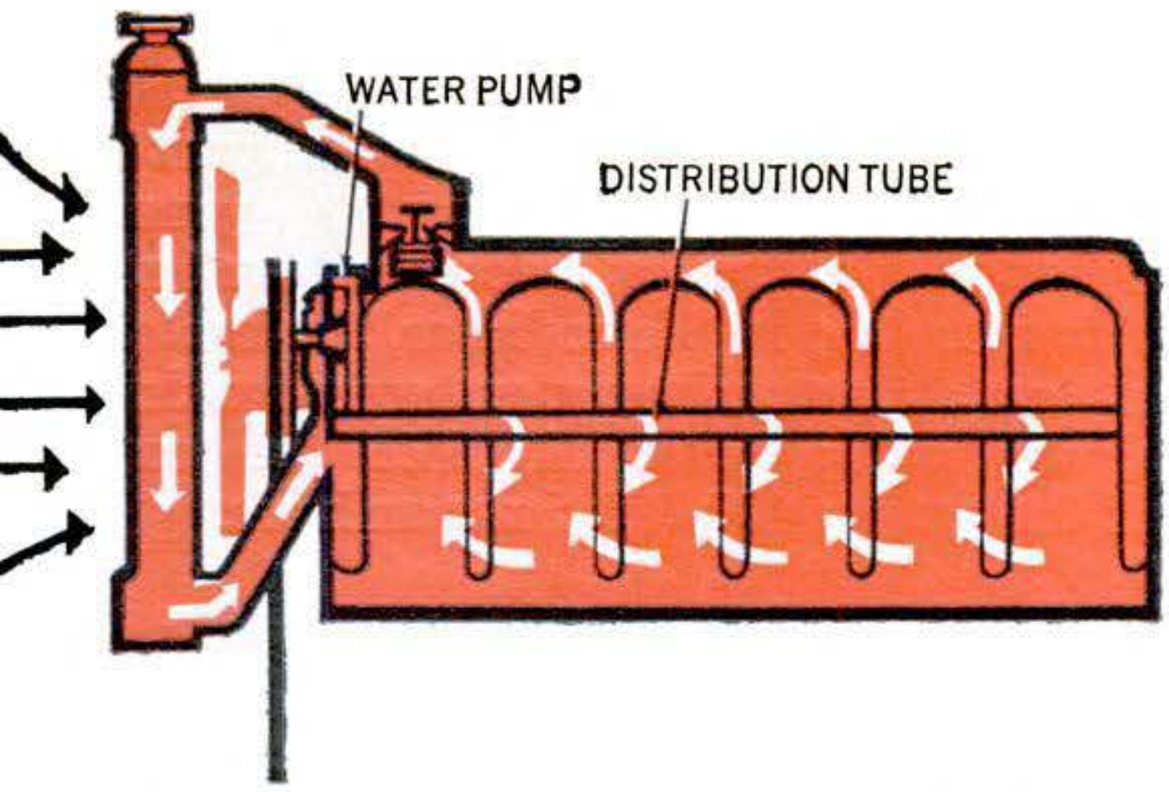
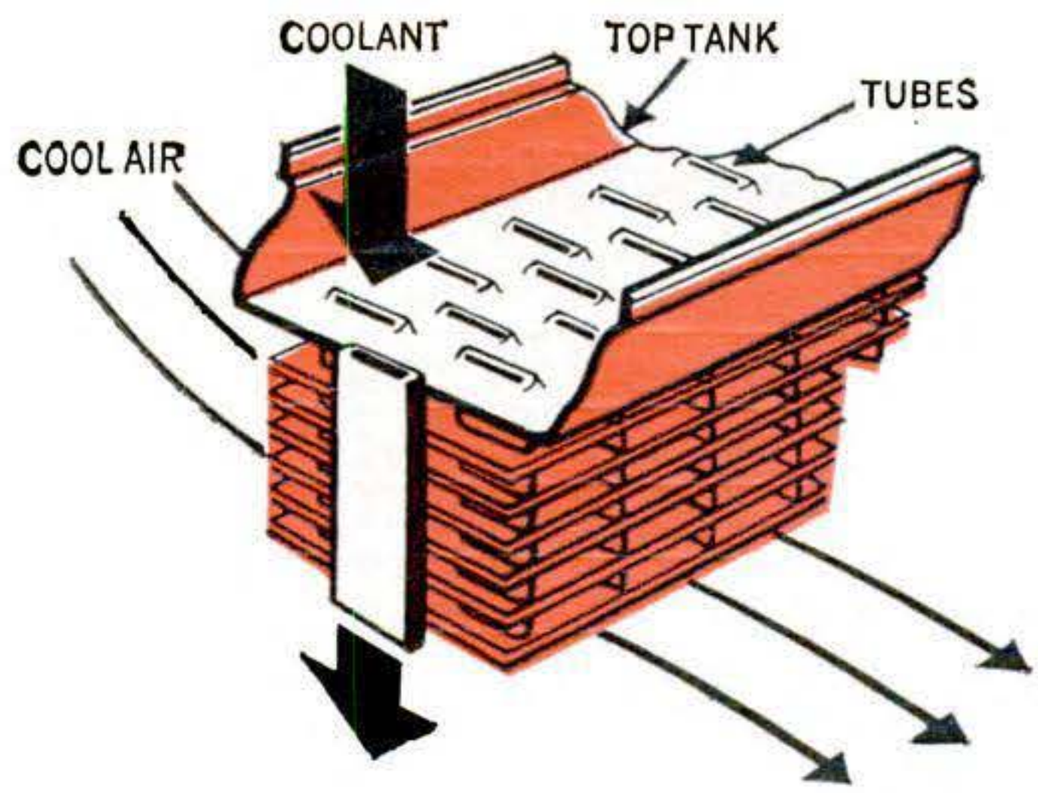



**Water pump** feeds cool coolant into a distribution gallery stretching the full length of the block. As the coolant is warmed, it flows to the heads and leaves the engine via the thermostat housing.




**Radiator core** is made up of metal strips soldered at the edges to produce narrow tubes. The coolant runs in the tubes, while fresh air flows through the spaces that separate the metal strips.

radiator. This circulation continues until the engine stops. The coolant absorbs heat from the engine and carries it to the radiator where the heat is released and the coolant cooled. The coolant is then returned to the engine, and the cycle is repeated.

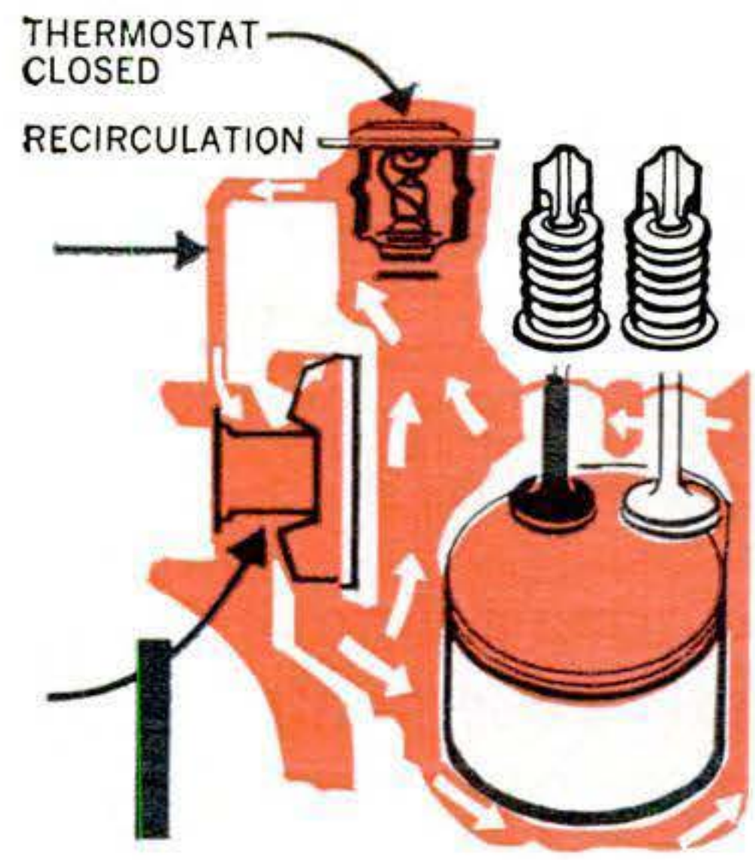
## How Heat Is Absorbed

The water jackets in the block are just hollow passages through which the coolant circulates to cool the cylinder walls and absorb the excess heat produced. The bigger passages surround the cylinders themselves; smaller ones are located to remove heat from valves and other hot spots.

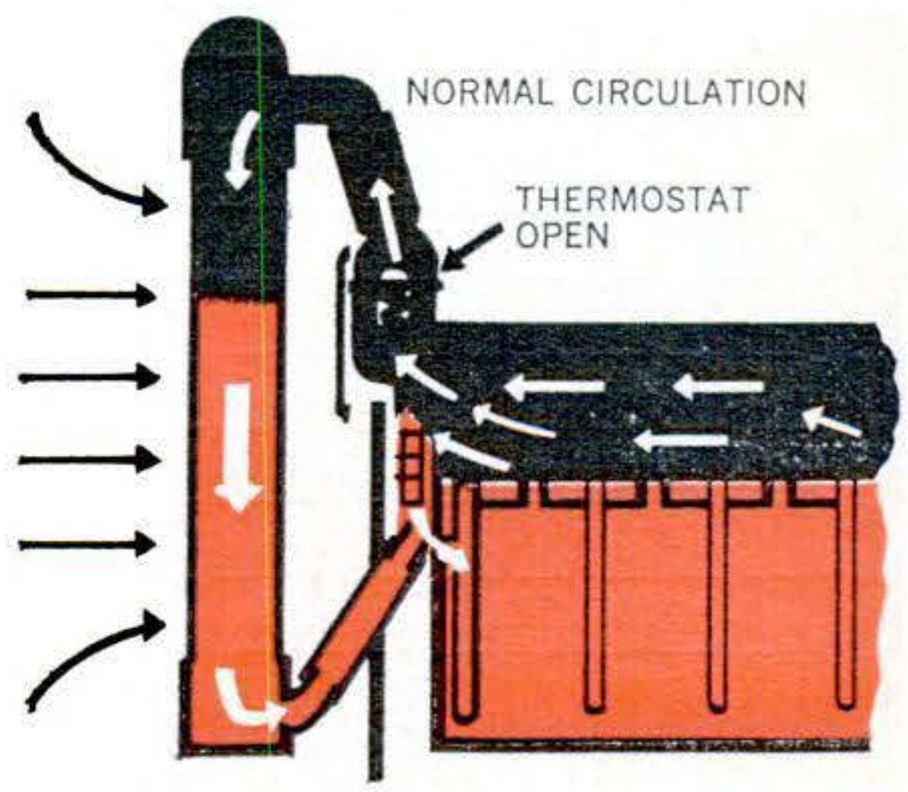
There are other passages in the cylinder head, and the coolant flows through them to cool the combustion chambers. Because temperatures developed there are often above 2,000 degrees F., the coolant must circulate rapidly. High-output engines have only a small cooling area at these locations due to overhead valves—so increased flow is provided by a recirculation bypass. This permits coolant to flow through the block even when the thermostat is closed.

A small centrifugal pump just in back of the fan, and driven by the fan belt, draws coolant

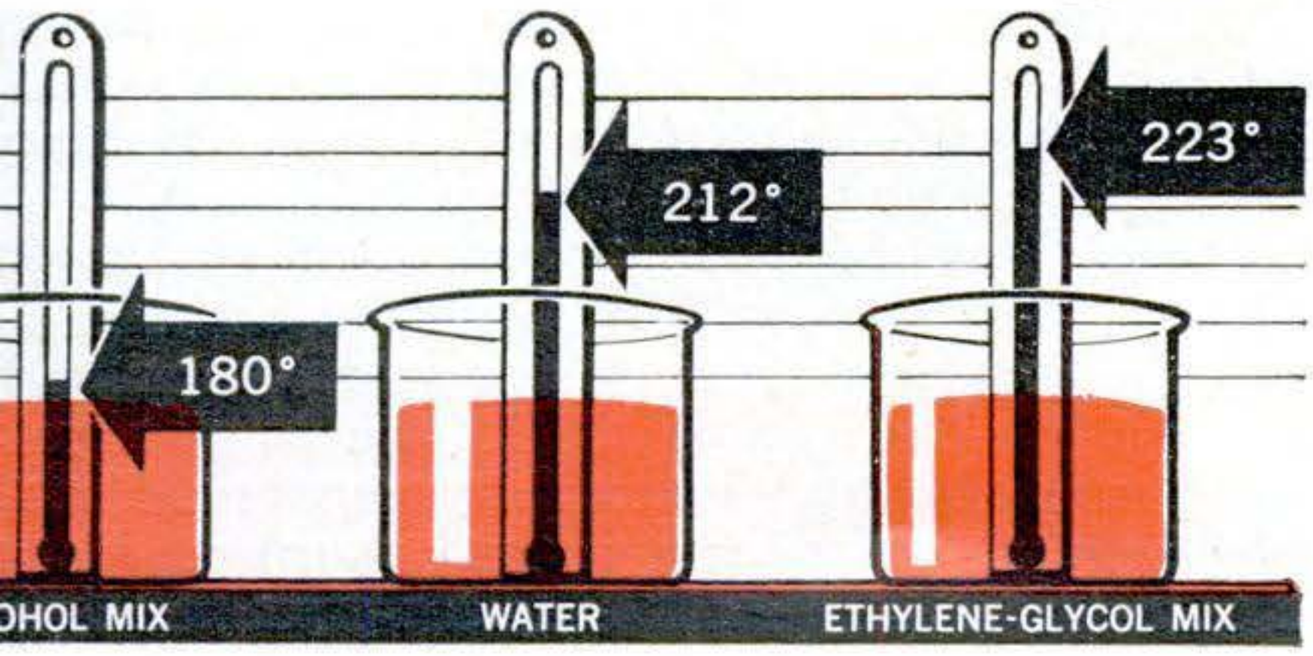
*Continued*




**When you start the engine,** the thermostat is closed and the coolant is cold. Before stat opens (at 180-200 degrees F.), the coolant circulates through the bypass.




**The thermostat is wide open** when the engine reaches normal operating temperature. The water pump assures rapid circulation throughout the cooling system.




**Alcohol-base antifreeze solutions** have almost disappeared. Alcohol evaporates before water, and when the engine runs hot, the freeze protection is gone.



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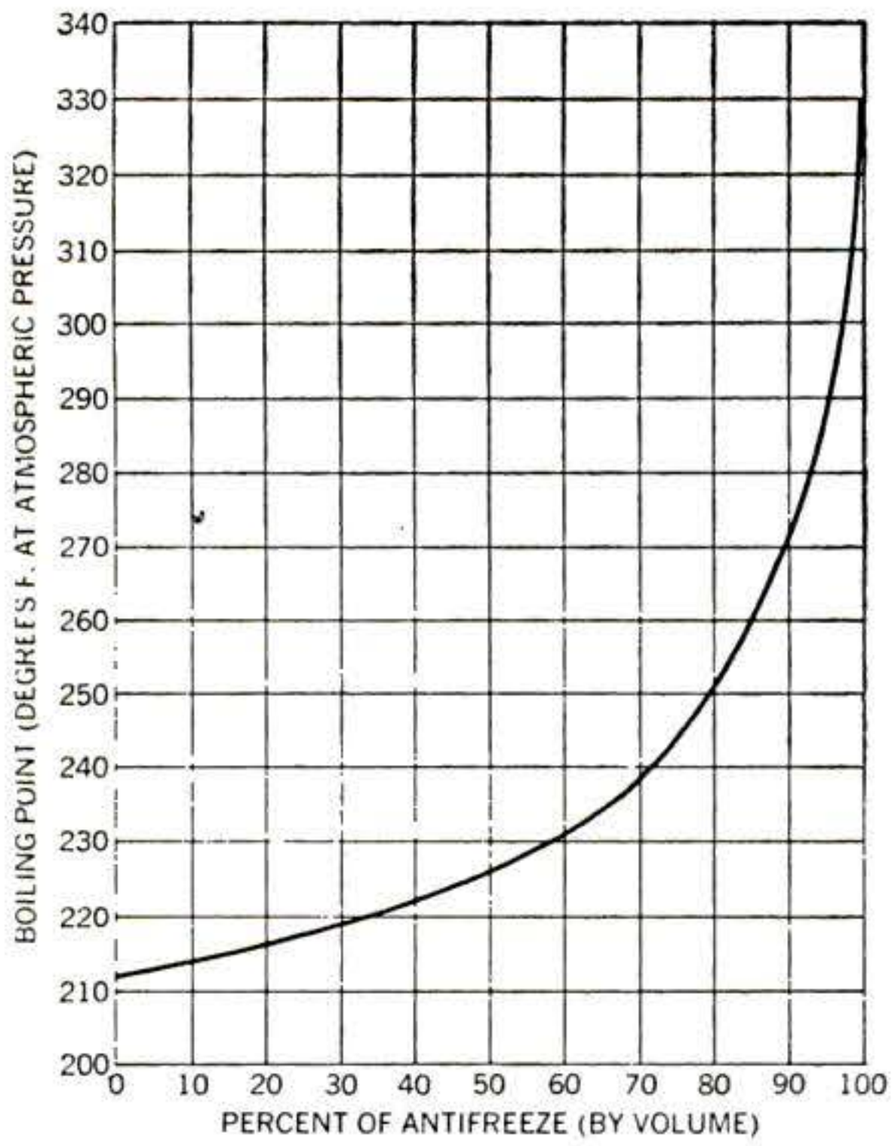
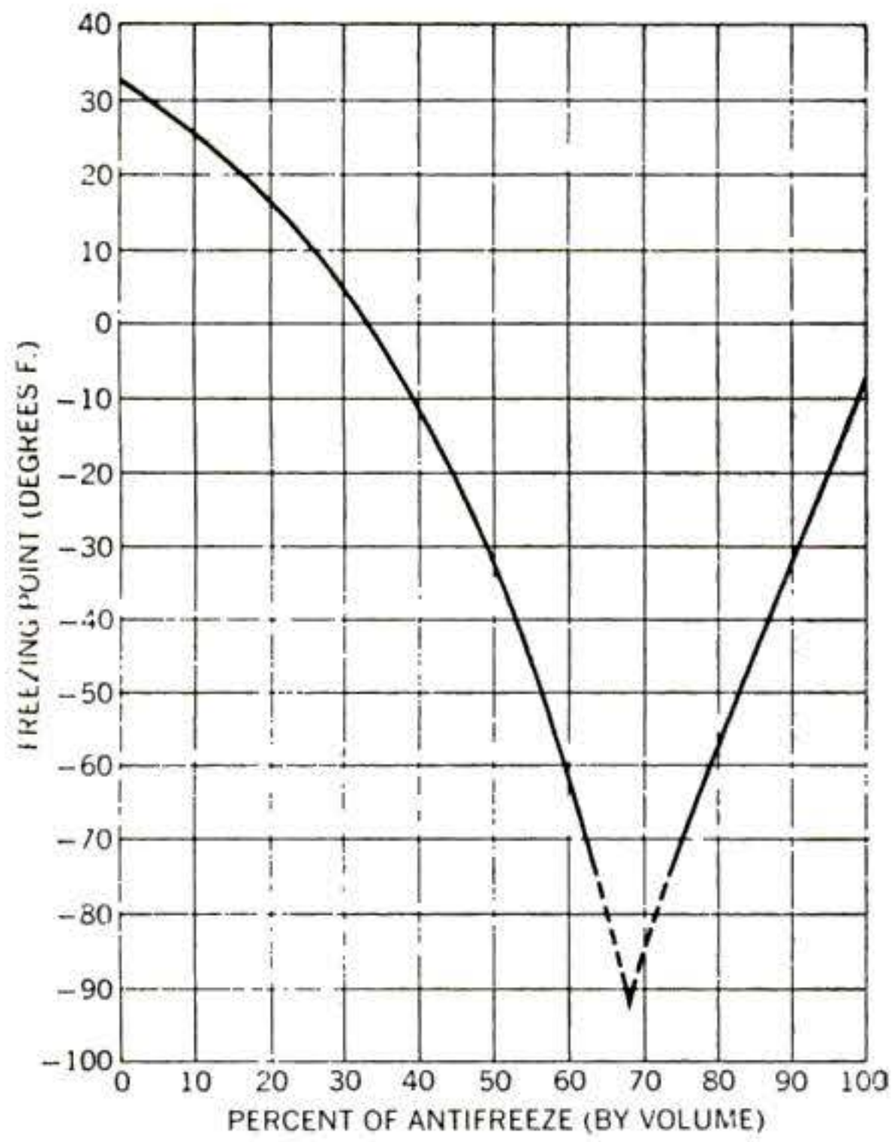
## Boiling points of the water-base antifreezes




**Ethylene-glycol mixtures** have extremely high boiling points. Vaporization loss is mostly water, which boils at lower temperatures, so you still have full protection.

## Freezing points of the water-base antifreezes




**The concentration** of the mixture determines the freezing point. Never use less than a 33-percent mixture or more than 65 percent; too little or too much increases the risk of freezing.

from the radiator and pushes it through the engine block and cylinder heads. The coolant then passes through the open thermostat (generally located between engine cylinder head and radiator). After cooling in the radiator, the coolant is recirculated. At normal temperatures and driving speeds, the pump must circulate the coolant through the system 400-700 times an hour.

# Cooling the Coolant

To remove waste heat from the hot coolant, the radiator—cellular or core, down- or cross-flow type—breaks the circulating coolant into many small streams for contact with a maximum of cool radiator surface. Even partial clogging of the tiny water tubes with rust, oil, or dirt lessens cooling capacity. As the coolant passes through the radiator, the fan draws cool outside air through its many small openings and over the tiny fins. The heat is thrown into the atmosphere.

The radiator may also have the job of keeping the transmission oil cool. A separate oil cooler is located on its cool side. Oil lines carry the hot transmission oil to this radiator where it is cooled and returned to the transmission.

The thermostat is a heat-operated valve in a housing between the cylinder head and the radiator. It controls the flow of the hot coolant. Today's cars use thermostats that begin to open from 180 to 200 degrees F. Although the thermostat cannot prevent overheating of the engine, it keeps the engine from overcooling, which is particularly important in cold weather.

# Talk About Coolants

The right antifreeze/coolant in the correct concentration is vital to the best operation of your car's cooling system.

High compression ratios, along with higher driving speeds, cause modern engines to operate at higher and higher temperatures. On the other hand, the lower hood lines have limited radiator size. So your coolant must operate at a higher temperature and have a higher boiling point. All-year use of antifreeze/coolants is now necessary to provide protection against overheating as well as freezing.

Water boils at 212 degrees F. at sea level, freezes at 32 degrees. On a modern car with a 15-p.s.i. pressure cap on the radiator, water will not boil until at almost 250 F.—the point where the warning light for overheating comes on. Thus, boiling starts *before* you get any warning. With a solution of 44 percent ethylene-glycol and 56 percent water, your coolant will not boil below



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264 degrees—and when the temperature warning light comes on, the coolant is *not* boiling. The antifreeze gives you an extra margin of protection against overheating.

While water will transfer heat slightly better than a water-and-antifreeze mix, a modern car's cooling system is designed for operating temperatures where plain water would boil away. Your cooling system will give best performance with 33 to 65 percent of antifreeze in the coolant. Because of the ease with which it accepts inhibitor additives, ethylene-glycol has become the only acceptable type of antifreeze.

# Just What Do The Inhibitors Do?

All the inhibitor systems claim to provide ultimate protection against corrosive action and excessive foaming. But two systems stand out: Prestone and Zerex.

Union Carbide says its Prestone is a two-phase system with a balanced formula: Both chemical inhibitors and a liquid called a Magnetic Film inhibitor are mixed with the concentrated ethylene-glycol. The Magnetic Film coats metal parts with a protective film less than 1/1,000 inch thick to seal off contact with the coolant and prevent penetration and loosening of old rust (cause of radiator clogging). It also lubricates the water pump. The chemical inhibitors are neutralizing

*Continued*

## CAR MAKERS' RECOMMENDATIONS FOR '68 CARS

| MANUFACTURER | CONCENTRATION OF FACTORY FILL | PERIOD OF USE OF FACTORY FILL | PERIOD BETWEEN REFILLS | CONCENTRATION OF ALL COOLANT ADDED BETWEEN | MINIMUM CONCENTRATION FOR YEAR-ROUND PROTECTION | FREQUENCY OF COOLANT-LEVEL CHECK |
|---|---|---|---|---|---|---|
| **American Motors** | 50% (−34°F.) | 24 months (2 years) | 24 months (2 years) | 50% | Not specified | Each 4,000 miles |
| **Chrysler** | 44% (−20°F.) | One year, then change each fall. Also, inspect every 6 months —drain, flush, refill, if coolant is dirty or rusty | One year. Inspect at 6 months—drain, flush, refill if system and coolant are dirty or rusty | Not specified | Not specified | Each gas stop. Don't check after driving in traffic, at high altitudes, very hot weather—unless overheating |
| **Ford** | 50% (−34°F.) | 24 months (2 years) Ford—cooling-system inspection every 12,000 miles or 12 months. If coolant is dirty, rusty—drain, flush, refill | Ford—24 months. Inspect every 12 months or 12,000 miles. Drain, flush, refill if dirty or rusty. — Lincoln, Mercury —cooling systems should be drained each year before winter, if "Rotunda" antifreeze not used | Ford—not specified — 50% Lincoln-Mercury | Ford—not specified — 50% Lincoln-Mercury | Once a month |
| **General Motors** | 44% (−20°F.) | 24 months (2 years) | 24 months (2 years) | 44% | 33% | Each oil change, every 4 months, not over 4,000 miles |



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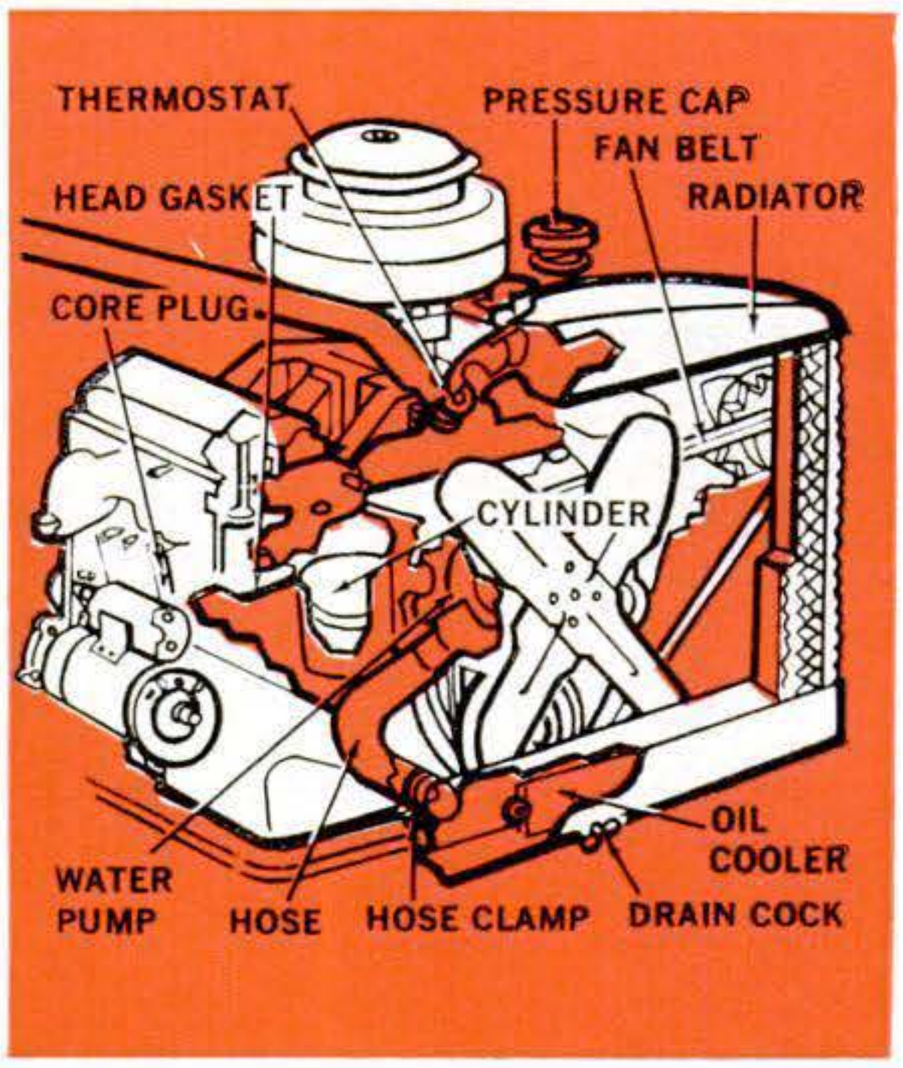
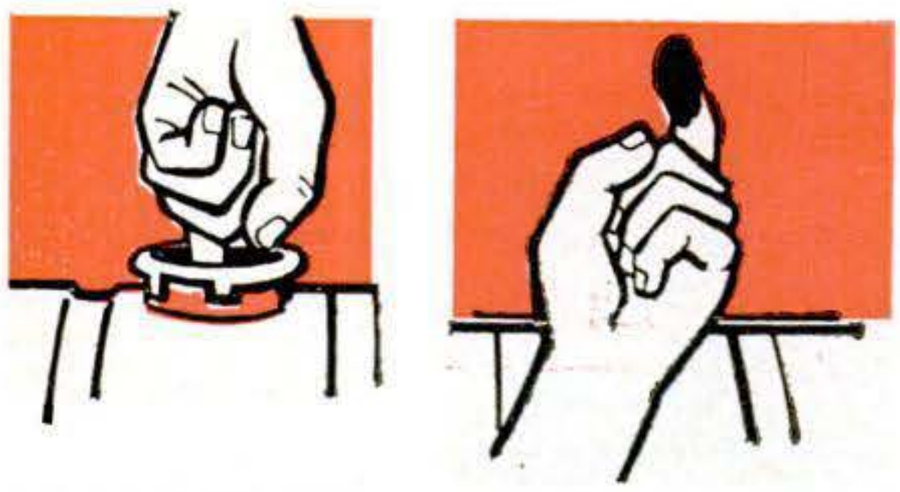



**Make a visual check** to locate trouble spots. Besides looking for leaks, check condition of hoses, hose clamps, pressure cap, and fan belt. Take time—take care.

**Check the rubber seal and vacuum valve** in the pressure cap. Replace cap if seal is hard, cracked, or compressed. Inspect the cap seat on the filler neck—and clean it.



**Peer inside filler neck**—foaming means an air leak. Run a finger inside the neck. If it comes out coated with grease, rust, scum, the radiator system needs flushing.

and buffering agents against corrosion. An antifoam agent is included, too.

DuPont's inhibitor system for its Zerex antifreeze/summer coolant is a chemical formulation. DuPont says it reacts chemically with metal surfaces, creating a chemical armor that halts electrolytic action, rusting, and corrosion. Rust in the system is held in suspension in the coolant and won't cling to an oily film. The inhibitors also provide considerable reserve alkalinity for neutralizing acids—caused by exhaust gases leaking through cylinder-head gaskets or air sucked through loose hose joints. Zerex also contains an antifoam agent.

Some coolants contain chemicals for special conditions. When you read the label and instructions on a can, make sure you are getting a complete inhibitor system. The manufacturer with the reliable quality product doesn't hesitate to tell you why his is the best.

## When a Coolant Tires

Like anything else, coolants wear out. They're circulating through the system between 400 and 700 times an hour. The inhibitors gradually deteriorate, even in a well-maintained engine. A coolant is no longer a coolant after serving a year or two under hard driving conditions in a leakproof system. A periodic check can save you the cost of a burned-out engine. And remember, too —a coolant isn't a coolant if it doesn't contain an inhibitor system to minimize corrosion.

## How Much Coolant?

Car and coolant manufacturers agree on the most effective minimum and maximum concentrations for ethylene-glycol solutions. Their recommendations are based on the present need for year-round antifreeze/summer coolant.

Never use a concentration of less than 33-percent coolant—for minimum protection. It will protect to 0 and boil at 220 degrees F. Maximum concentration—65 percent—protects to —60 degrees and boils at 240. Higher concentration will ruin your freezing-point situation. A 100-percent concentration protects to only about 0 degrees. Some coolant makers say a 50 percent solution is best; it protects to —34 and boils at 226 degrees. A 50-percent concentration gives near-maximum protection both winter and summer.

## Who's Going to Do It?

Car owners are puzzled by differences in factory recommendations. The confusion is multi-



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lied at service stations, which must service all nakes of cars but lack complete information bout each manufacturer's warranty. The warranty points to the car dealer—who is often not nterested in checking cooling systems and relacing coolant. As one dealer expressed it, "I on't want my shop known as a place to check ooling systems. I've got too many problems to vorry about those jobs."

Your warranty says to go to your car dealer. Sut he may delay you beyond a safe date. Beore taking the next step, read your warranty.

The second route may be a service station. Most of them have pressure-testing equipment, oists, hydro-guns, special tools and gauges. What they may lack is time, desire, or training.

The oil companies say their stations are slow o adopt special incentive plans in this field, ut there is growing interest. If you go to a servce station, ask to have your system completely hecked, flushed, and filled with a coolant conentration of no less than 33 percent. Naturally, he cost will be higher than at a discount or autohotive chain store.

The third route is to do your own checking nd refilling. You don't need experience and ou may be able to make repairs, too. But there nay be a point where you must turn the job over o the professional. We'll talk about that later.

## Why All the Confusion?

As recently as 15 years ago, 90 percent of oolant was sold or installed by service stations. The attendants were trained and experienced, nd the job was done right and fast. But sudenly the situation changed.

The big chains and discount stores entered the narket with mass-merchandising techniques. At he same time, the quality and experience of ervice-station personnel began to deteriorate.

In less than 10 years, the chains and discountrs were selling about two-thirds of the coolant.

More and more car owners now put in their wn coolant. If you do, read the labels on the oling-system chemicals and learn something bout the cleaning, corrosion-inhibiting, sealing, nd foam-stopping ingredients used. Buy what onforms with the recommendations in your wner's manual.

## When to Change?

As the market switched, auto makers, too, disovered the changing antifreeze buying habits of heir car owners. To meet these marketing probems they invented the Warranty Systems—the

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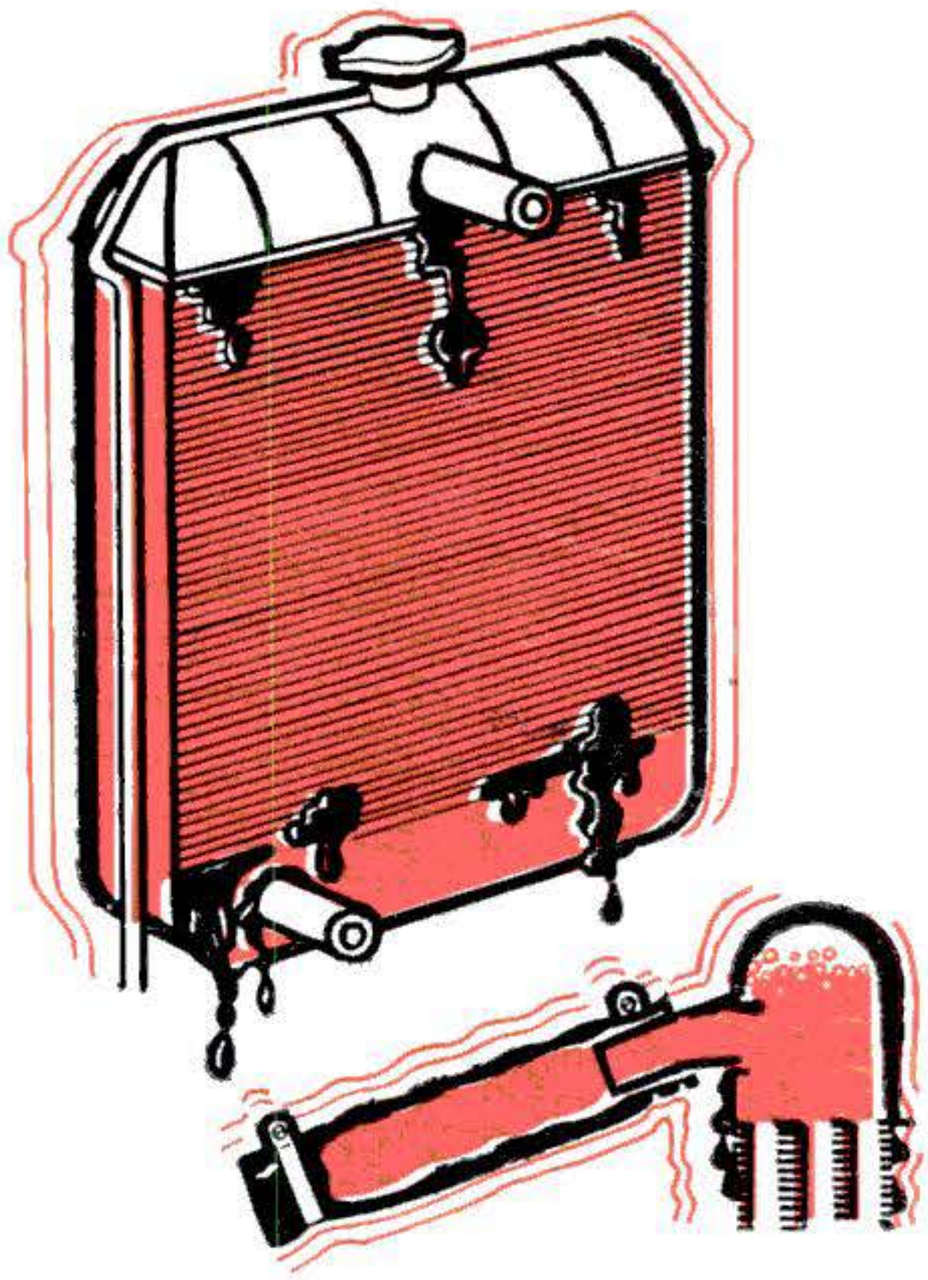
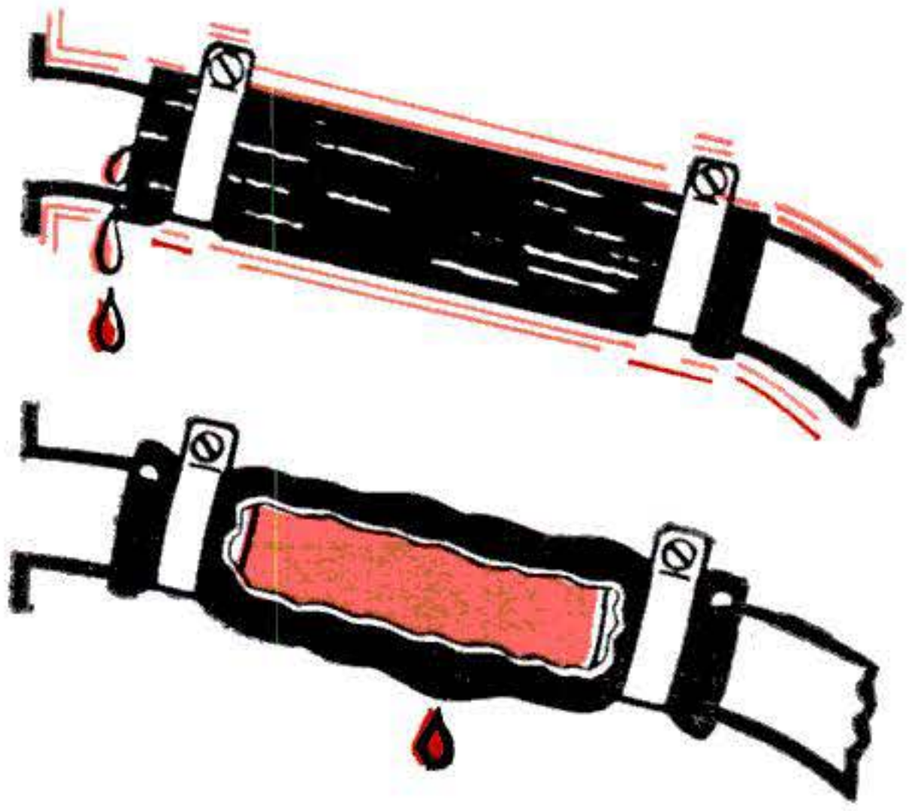


**Look for leaks on main radiator**—dye will give telltale stains. Inspect the areas where the tanks are soldered to the core, and scrutinize intake and outlet pipes.



**Hoses can fool you**—the inside may be breaking up even though the outside looks perfect. Replace hard, soft, swollen, or cracked hoses. Keep the clamps tightened.

**Fan belt** drives water pump, fan, and, on most of cars, alternator. Slipping usually leads to overheating and extra belt wear. Check for tears, fraying, and oily or glazed sides. Tighten if loose; replace if too worn.



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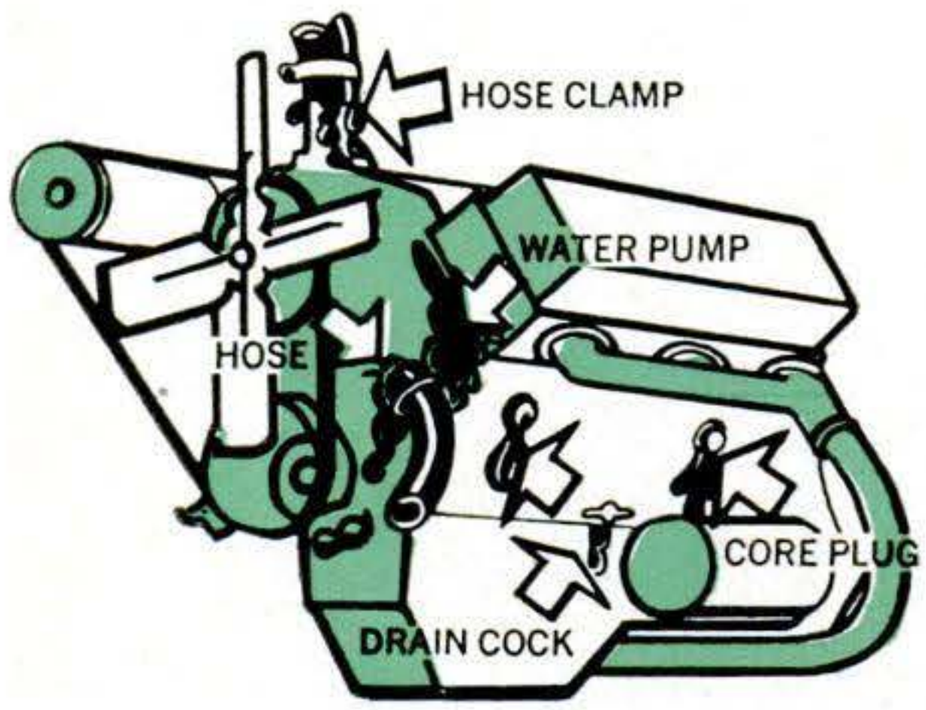
## PS Extra: ANTIFREEZE




**Check the engine block** for external leaks. Stains from coolant dye will show at core plugs, head gaskets, water-pump seals, and thermostat-housing seals. Check radiator and heater connections. You can fix most leaks without special tools.

2/25 (2 years or 25,000 miles) or 5/50 (5 year or 50,000 miles) systems. You're directed t take your car for a periodic Warranty Check It is the dealer's responsibility to repair and re place parts. He charges you or the car manufac turer, depending on the Warranty. To keep cost down, they put in the original charge of ethy lene-glycol coolant at the factory and recommen that it be kept for one or two years. Chrysle recommends one year; General Motors, Ford, an American Motors, two years.

The coolant makers recommend that coolant b changed once a year to assure full protection o your car's engine. But their coolant inhibito systems vary and the claims they make for ther are often opposed.

Auto makers began to fill antifreeze at th factories in 1962.

Pontiac claims that their experience shows n specific problems resulting from a two-year chang interval when the owner's-manual recommenda tions are followed.

C. D. Woods of Dow Chemical says, "All re fills should be for one year if the system is prop erly maintained and coolant concentration is kep at 33 percent."

Chrysler Corp. takes the position that th antifreeze/coolant should be drained and a ne charge installed after one year and in the fall o each succeeding year.

Marshall Stephens, National Sales Manage for DuPont Auto Products, says, "Antifreeze i

## How Many Quarts Do You Need?

| Cooling-System Capacity in Quarts | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | −12° | −62° | | | | | | | | | | |
| 6 | 0° | −34° | | | | | | | | | | |
| 7 | 7° | −17° | −54° | | | | | | | | | |
| 8 | | − 7° | −34° | −69° | | | | | | | | |
| 9 | | 0° | −21° | −50° | | | | | | | | |
| 10 | | 4° | −12° | −34° | −62° | | | | | | | |
| 11 | | 8° | − 6° | −23° | −47° | | | | | | | |
| 12 | | 10° | 0° | −15° | −34° | −57° | | | | | | |
| 13 | | | 3° | − 9° | −25° | −45° | −66° | | | | | |
| 14 | | | 6° | − 5° | −18° | −34° | −54° | | | | | |
| 15 | | | 8° | 0° | −12° | −26° | −43° | −62° | | | | |
| 16 | | | 10° | 2° | − 8° | −19° | −34° | −52° | | | | |
| 17 | | | | 5° | − 4° | −14° | −27° | −42° | −58 | | | |
| 18 | | | | 7° | 0° | −10° | −21° | −34° | −50° | −65° | | |
| 19 | | | | 9° | 2° | − 7° | −16° | −28° | −42° | −56° | | |
| 20 | | | | 10° | 4° | − 3° | −12° | −22° | −34° | −48° | −62° | |
| 21 | | | | | 6° | 0° | − 9° | −17° | −28° | −41° | −54° | −68 |
| 22 | | | | | 8° | 2° | − 6° | −14° | −23° | −34° | −47° | −59 |
| 23 | | | | | 9° | 4° | − 3° | −10° | −19° | −29° | −40° | −52 |
| 24 | | | | | 10° | 5° | 0° | − 8° | −15° | −24° | −34° | −46 |

For protection to temperatures shown in degrees F.

IDEAL PROTECTION 50% ANTIFREEZE

MINIMUM PROTECTION 33% ANTIFREEZE



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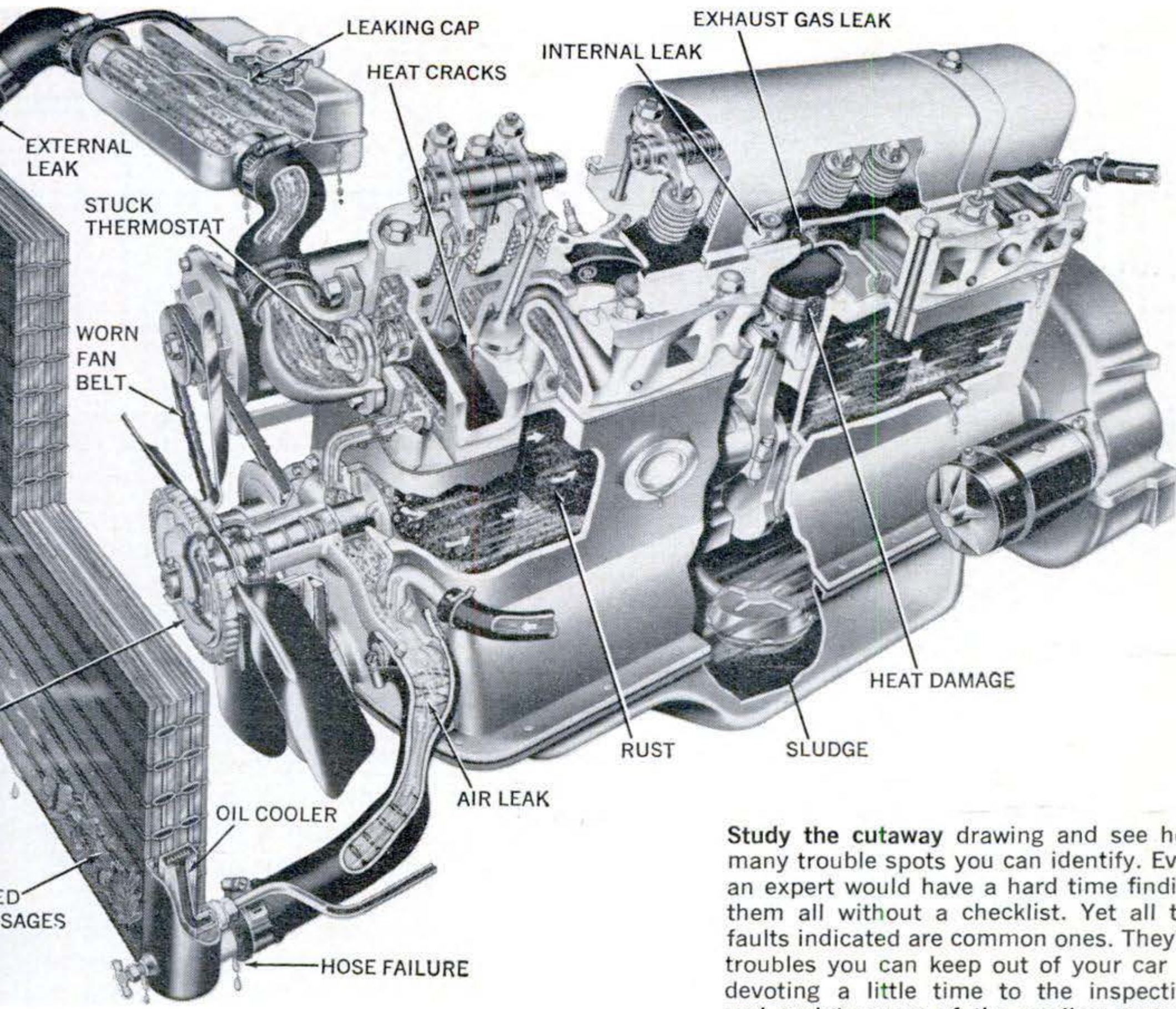
## ere are the troubles you can avoid by careful maintenance




**Study the cutaway** drawing and see how many trouble spots you can identify. Even an expert would have a hard time finding them all without a checklist. Yet all the faults indicated are common ones. They're troubles you can keep out of your car by devoting a little time to the inspection and maintenance of the cooling system.

alled in a properly operated and properly main-
ined cooling system could probably be used two
ars without any trouble."

# And New-Car Problems, too

Union Carbide has been conducting a consumer
rvey of cooling-system problems that develop
new cars. Herb Hannigan, their spokesman,
ys, "About one-third of all new cars need cool-
g-system maintenance and new coolant in their
st year. About half during the second year
ve coolants which are deficient in some way."
What's the problem—cooling-system design or
or service practices? Hannigan's answer is poor
rvicing. Antifreeze/coolant can provide satis-
ctory service year round in a leak-tight system
en accompanied by periodic cooling-system in-
ection and preventive maintenance. "But," says
annigan, "many coolants don't give even one-
ar service because of mechanical factors, in-

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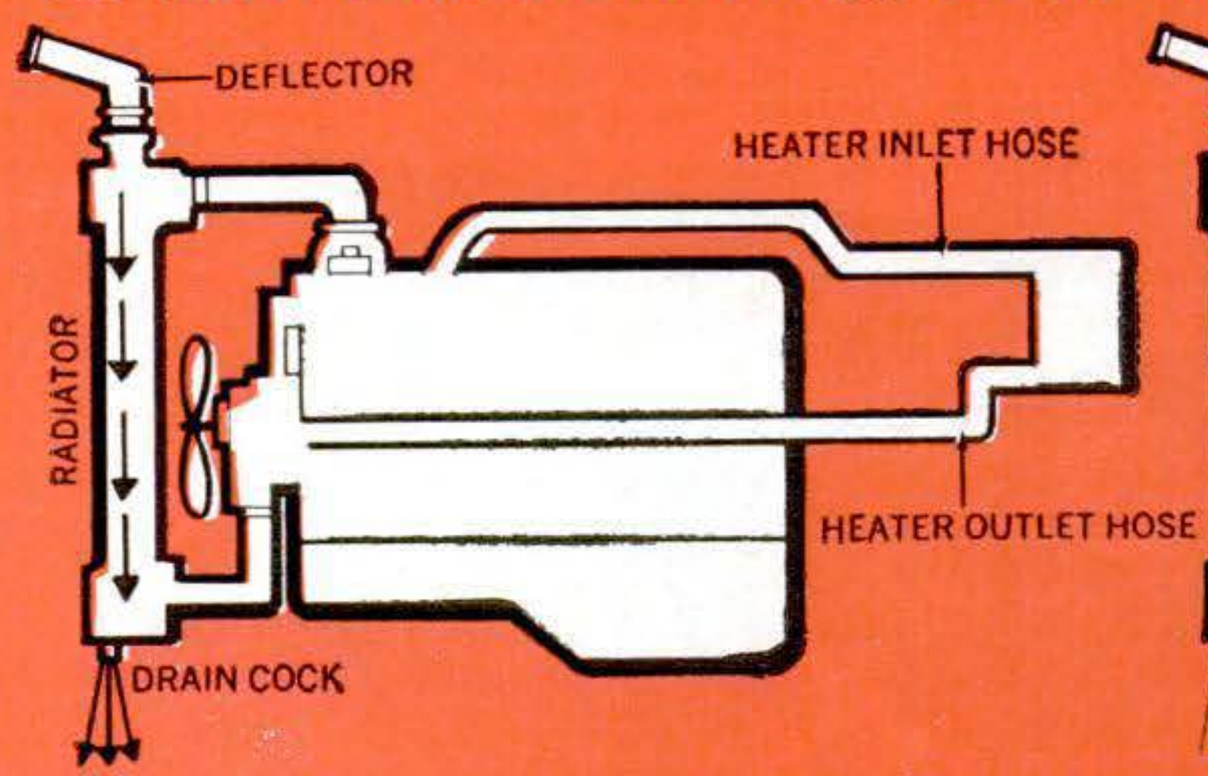
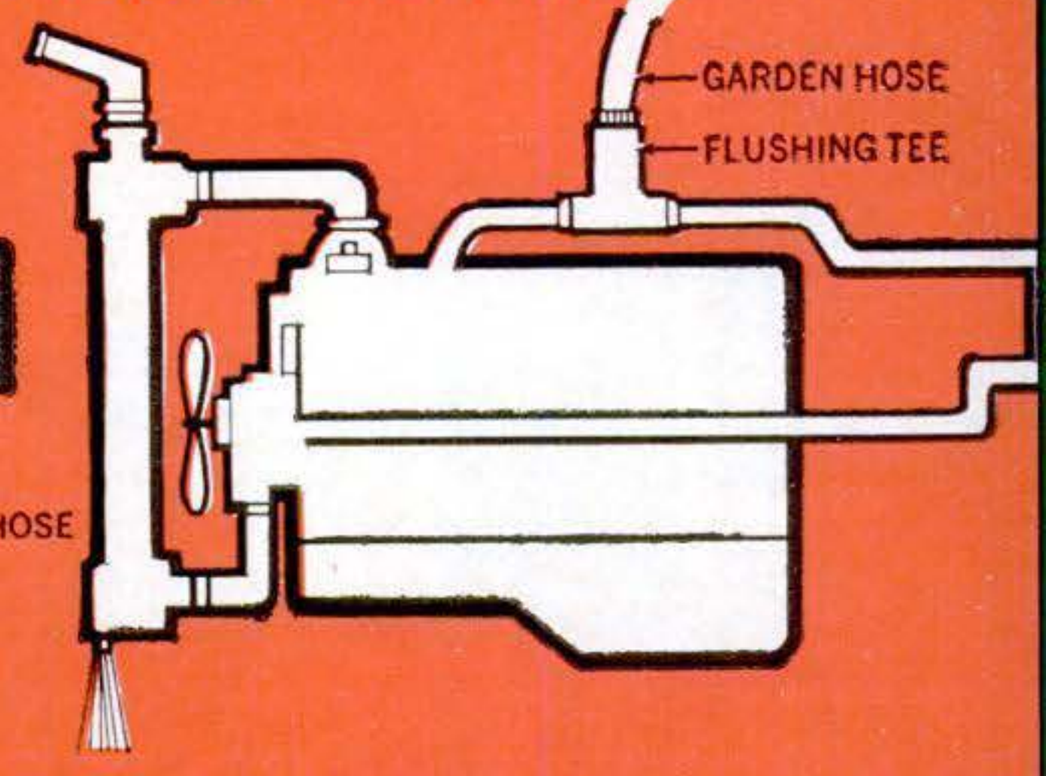
## For most effective flushing, use the reverse-flow method




**1** **Open the radiator drain cock,** remove the radiator cap and drain the radiator completely. Fit the deflector elbow (shown in photo below) in the filler neck and connect it to a hose that will carry away the drain-off. Close the radiator drain cock only when the system has been completely drained.

**2** **Install the flushing tee** (also shown below) the heater inlet hose. Be sure you have right hose. The tee goes on the hose that's c nected to the cylinder head, not on the one th connected to the water pump. Use the hose cou to connect the flushing tee with your garden h

hibitor depletion from natural causes, and poor servicing. Service-station men and car owners overfill—causing excess coolant to spill through the overflow pipe. They remove radiator caps from hot engines, resulting in coolant overflow. Hoses and clamps are seldom checked for leakage, and gasketed joints are rarely checked for correct torque."

Car makers, coolant makers, and the oil companies all agree that the worst and most common mistake is failure to thoroughly check for leaks and worn parts. The second error is insufficient drainage of old coolant.

# How to Drain the System

When you have completed your visual inspection, you're ready to drain the old coolant. Re-

**Simple accessories** make the reverse-flow method of flushing easy. It will cost you about $1.50 for all three of these, and you can buy them at most large chain and discount stores. The coupler and flushing tee are made for a ⅝-inch garden hose, and the deflector fits filler necks of standard radiators.



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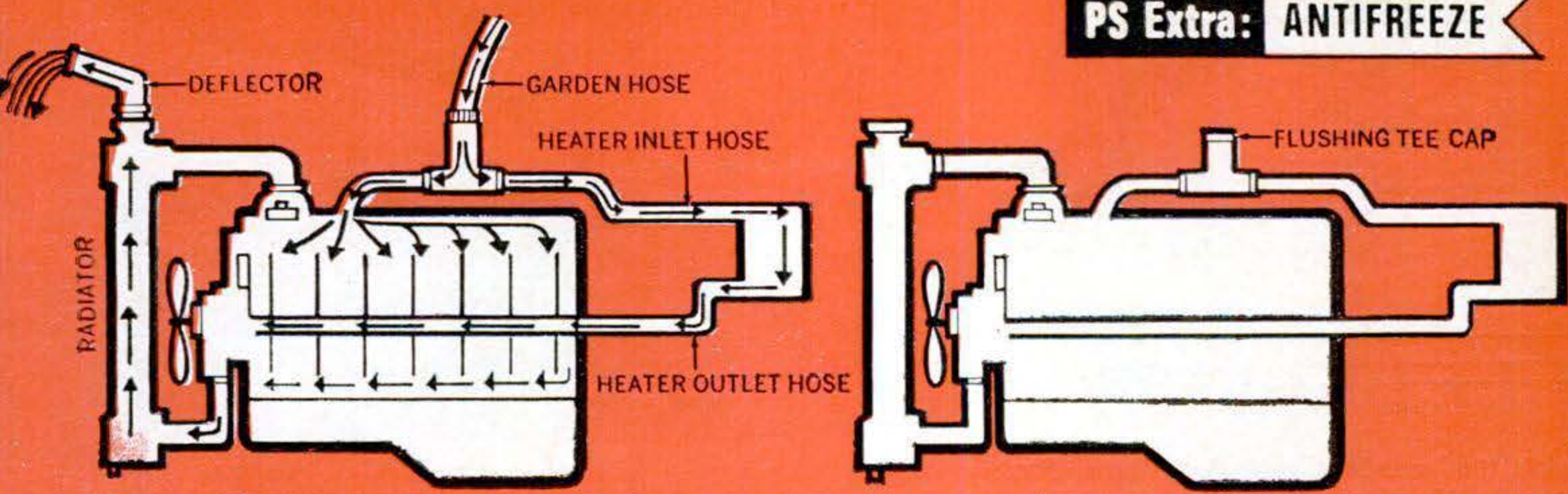


**3** **Set the temperature control** at High. If your car has a vacuum-operated heater or factory-installed air conditioning, let the engine idle while flushing. Turn on the cold water to keep the thermostat closed and flush for five minutes (or until the flushed-out water is running clean).

**4** **Before you turn off the water,** be sure you turn off the engine. Open the drain cock. Squeeze the upper radiator hose several times to remove trapped liquid. Remove garden hose. Place cap on flushing tee (and keep permanently installed). Close drain cock, and system is ready for fresh coolant.

pairs and adjustments can be made before you fill the fresh charge. Do not start the engine! Open the radiator and cylinder-block drain cocks. If the car heater is equipped with a drain plug, open it. If it isn't, turn the heat control to the maximum-heat position.

Take a good look at the coolant you've just removed. If it's rusty, greasy, and dirty, the system is probably loaded with rust and other corrosives. These must be removed by chemical cleaning and back-flushing. If the coolant is clean or just slightly contaminated, you can use a light-duty chemical cleaner.

Caution: Dispose of the waste coolant by immediately flushing it down your garage drain, using plenty of water to dilute and get rid of it. Or bury it! Remember, it is a poison and can be fatal if swallowed.

For reverse-flow flushing, I prefer the use of a flushing tee, installed in the heater inlet hose, and a hose coupler on my garden hose. (Both are shown in a photo.) A ⅝-inch garden hose is screwed into the coupler and the inlet of the tee.

# Overheating—Its Causes and Cure

If your engine is feverish and has developed a case of overheating, you'd better get ready to talk with your dealer or garage mechanic. But first check the cooling system at the most obvious trouble points. Maybe you can diagnose and correct the problem yourself.

First and easiest to detect are coolant loss, restricted radiator air flow, dirty exhausted coolant,

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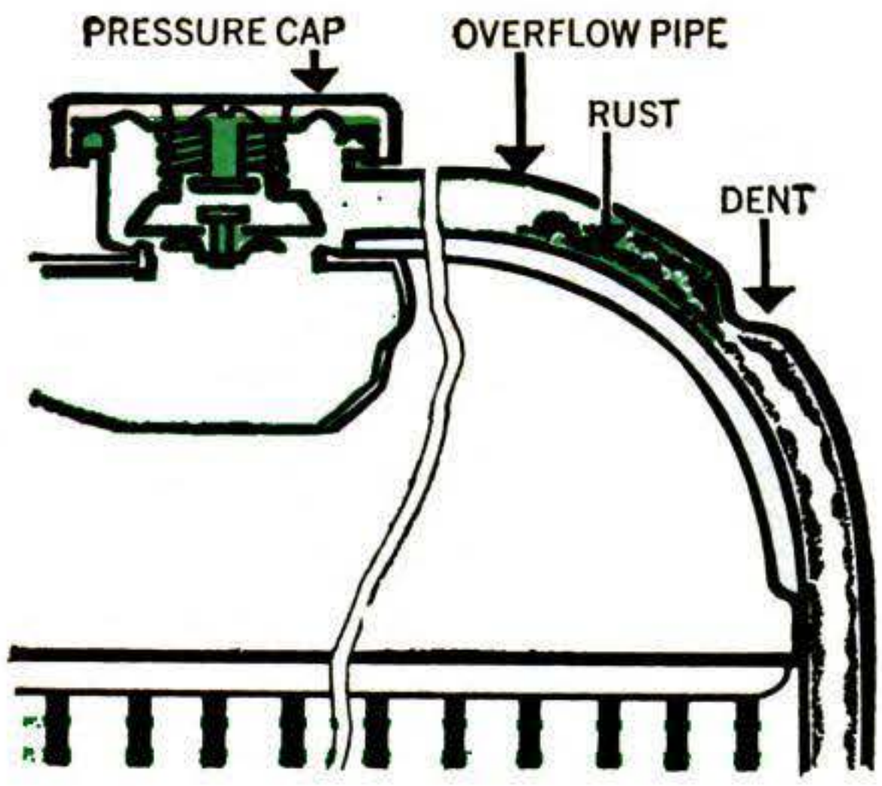



**Check the overflow pipe** for dents. Rust usually forms on the inside near the restriction, and can eventually cause complete clogging of the pipe.

Your garage or service station is equipped to check your pressure cap. Caps that don't hold their correct pressure are a frequent cause of overheating.

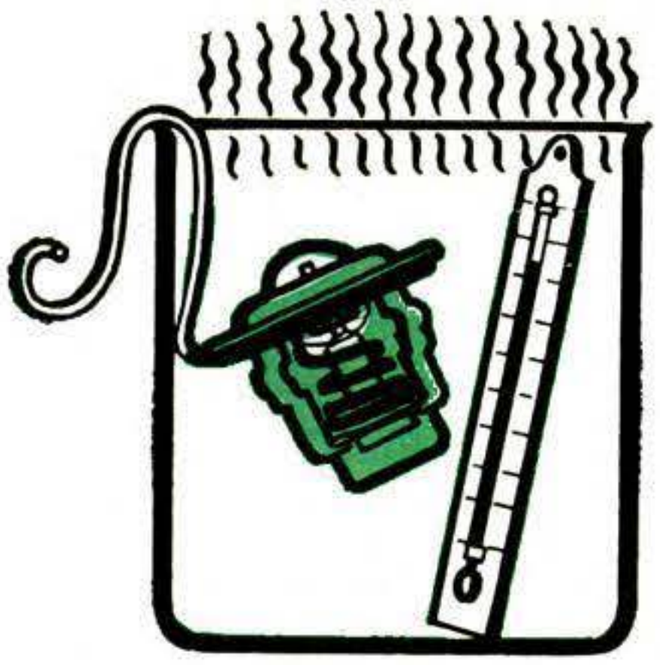
and external leakage. Internal leakage cannot be seen without special equipment. You should let the professional take over when you suspect this is the problem.

# Slow Warm-up and Overcooling

Whenever the gauge on your instrument panel —if you have one—shows that the engine is operating below normal temperatures, determine the reason. Continuous low-temperature operation wastes fuel, increases engine wear, leads to rough engine operation, and produces corrosive sludge in large quantities. Sludge can interfere with the lubrication of pistons, rings, valves, and hydraulic valve lifters. The final result can be lubrication failure and serious damage to your car's engine.

The reasons for overcooling or slow warm-up shouldn't be difficult to diagnose. What about your recent driving—many stops and starts, excessive idling, cold weather, low speeds? If none apply, check your thermostat. It may be defective or stuck in an open position—or you may be operating your car without one. Finally, check the temperature gauge. It may be inaccurate.

The thermostat plays an important part in maintaining the temperature of the coolant as it circulates. Its action is particularly important during warm-up. During this period, it is closed and the coolant is held in the engine while



**Check the opening temperature** of your thermostat in a can of water with a thermometer. Heat water and watch for stat's valve to open. If it opens at about its rated temperature (stamped on unit) and closes when cooled off, it's okay. If not, replace.

**Three types of thermostats** are used to control temperature and regulate flow of coolant. Thermostats in modern cars begin to open at 180-200 degrees F. Replace defective one with type recommended for your engine and coolant. Faulty installation can damage engine—follow instructions.



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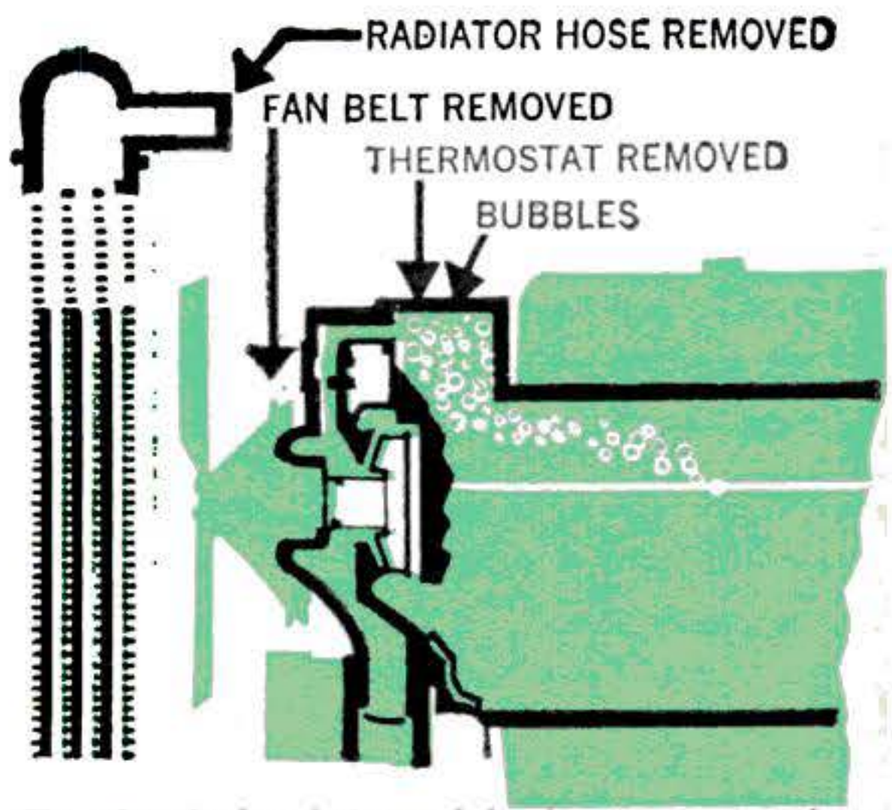
it is being heated. Only a small amount is circulated through the bypass. If the thermostat is stuck in the open position, you get slow warm-up. If it's stuck in the closed position, you'll get overheating because the coolant doesn't circulate properly.

Modern thermostats last a long time, but if you have an overheating or overcooling condition, be suspicious of the thermostat and check it. It's in a neck on the cylinder-head outlet. Remove the hose and the thermostat housing and lift out the stat. If it's open, examine it first for dirt or rust, which can keep it from closing. If it is closed and looks all right, test it for faulty operation.




**To check** for internal leaks, remove thermostat, fan belt, and radiator hose. Then start the engine and watch for gas bubbles in coolant in thermostat housing.

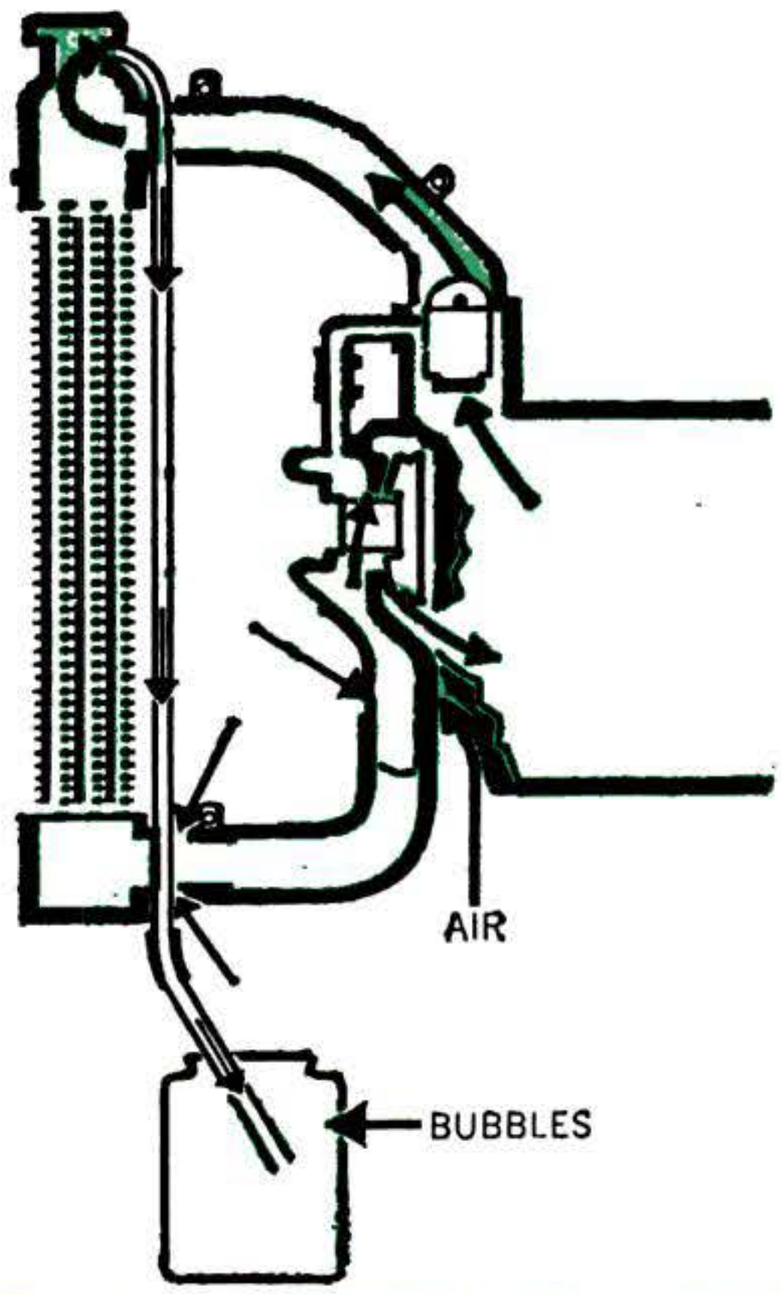
# Internal Leakage?

Internal leakage is hard to detect, but if it isn't located and promptly corrected, you're asking for trouble. When coolant is exposed to exhaust gases it reacts with them to form corrosive acids that attack metals and accelerate rust formation. The gases also destroy the inhibitors in the coolant. Gas blowing into the coolant can also force coolant out of the radiator overflow pipe and produce overheating.

Leaking gas can corrode and burn cylinder-head gaskets, which may then pass coolant into the combustion chamber and crankcase. Use this test if you suspect internal leakage:

With the engine cold, inactivate the pump by removing the fan belt from the drive pulley. Drain off about a quarter of your coolant. Remove the hose to the radiator, the thermostat housing, and the thermostat, and fill the radiator until the engine block is full and level with the top of the thermostat seat. All trapped air will now have been removed.

Set the parking brake and chock all the wheels. Put the selector lever in Drive (or top gear), apply the foot brake, and intermittently load the engine by slowly depressing the accelerator. (Keep people away from the front of the car.) Observe the thermostat-block outlet—a sudden rise of liquid there indicates exhaust-gas leakage, usually caused by a cracked cylinder head or a loose, burned, or damaged cylinder-head gasket.




**To check for external leaks,** run extension tube from overflow pipe into jar of water. Start engine and watch for air bubbles in jar. Most leaks can be located visually.

# Test for Air Suction

Coolant foaming is a common problem. If you see foam in the radiator filler neck, your cooling system is in trouble. The main cause of foaming is aeration, which may be caused by loose radiator hoses, a leaky water pump or radiator, a bad head gasket, or even a cracked head or block. Whatever the cause, air is being sucked

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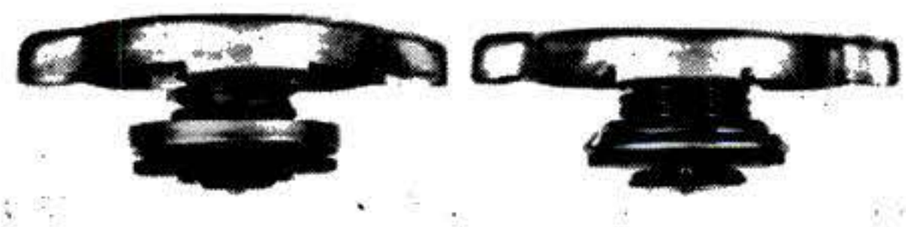

**Pressure caps** come vented and non-vented. Cap at right has a vented vacuum-release valve to delay pressure buildup until vapor or hot coolant closes valve.



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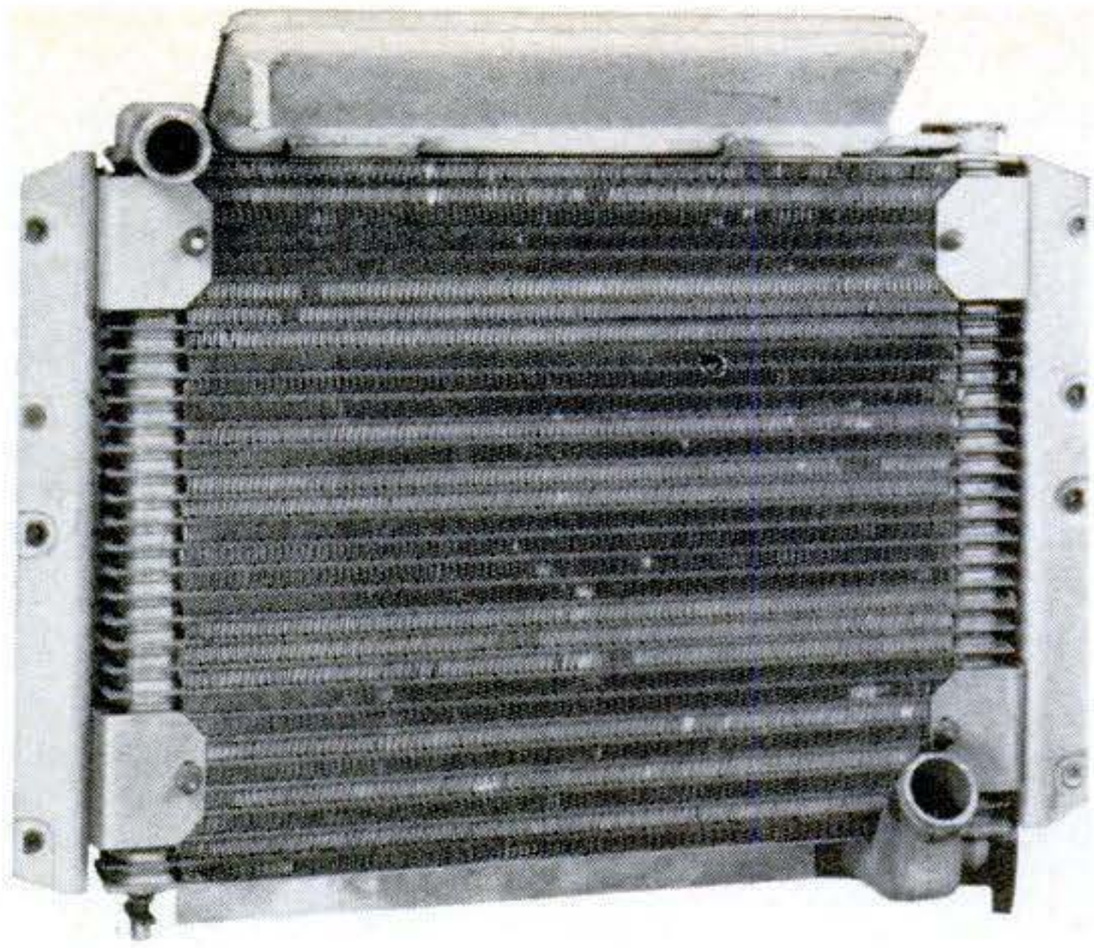

**Downflow radiator** (left) is now used mostly in the smaller, low-priced cars. Crossflow type (right) was developed to give increased capacity with the lower hood lines that are found on today's cars.

into the system—and you must locate the spot and correct the condition.

Here's how to check. The cooling system should be at the correct level in the radiator—1½-2 inches below the filler neck. This allows for expansion and avoids overflow loss during the test. Remove the regular pressure cap; use a plain airtight cap. Attach a length of rubber tubing to the lower end of the overflow pipe (pipe, tubing, and pressure cap must all be airtight). Start the engine and operate it in Neutral at a safe high speed until the temperature gauge indicates normal, or until the *cold* light turns off. Keep the engine going at the same speed and place the end of the rubber tubing in a bottle of clean water. Bubbles in the water show that air is being drawn into the system.

**Flush is light-duty cleaner** for use when there's not much rust or grease in system. Heavy-duty cleaner attacks hard rust and other corrosives. Antirust gives extra corrosion protection. Sealers stop internal leaks as well as minor radiator leaks.

## Check Pressure Cap

That little cap on your radiator—which the service-station attendant so often removes to check the level of your coolant—is a vital part of the cooling system. The system can't perform to its full capacity if the cap isn't the right type or isn't operating properly.

The cap's main function is to maintain correct pressure in the system. This pressure increases the coolant's boiling point, reducing the possibility of overflow loss. It will also minimize overflow caused by aeration, which can result in foaming and air entrapment in the system.

There are vented and nonvented pressure caps. Both consist of a pressure valve and a vacuum-release valve. The pressure valve consists of a rubber gasket or seal held firmly against the bearing surface of the filler neck by a carefully



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calibrated spring. The spring, depending on the rating of the cap, will allow the valve to open at 12 to 19 p.s.i.

When the coolant cools, the nonvented (or constant-temperature) type allows the system to become pressurized as soon as the coolant becomes hot. The vented type has a weighted vacuum valve that hangs open until forced to close by a surge of vapor or hot coolant. Pressure does not build up until this vacuum valve is closed.

## The Radiator—the Heat Remover

The most important and hardest-working part of the cooling system is its main radiator. It receives a continuous stream of hot coolant and in a few seconds cools it for return to the hot engine. Air flows over its fins and core openings and cools the coolant. The air is moved rapidly through the open air passages by ram pressure, partly from the car's forward movement, partly by suction from the engine fan.

When inspecting for leaks, look closely at both the hot and cold tanks where they're soldered to the radiator core. Vibration may have broken the solder seal. Also check the transmission oil cooler at its inlet and outlet joints.

## Maintenance—and Chemicals

Knowing when and how to use chemical cleaners, sealers, and antirust compounds is a must.

Coolant makers caution against attempts to buffer or replenish inhibitors. They claim that the inhibitor systems of their coolants are balanced and complete, and, except as covered in their instructions, nothing should be added. Additional chemicals may actually contaminate the inhibitors and cause them to lose effectiveness.

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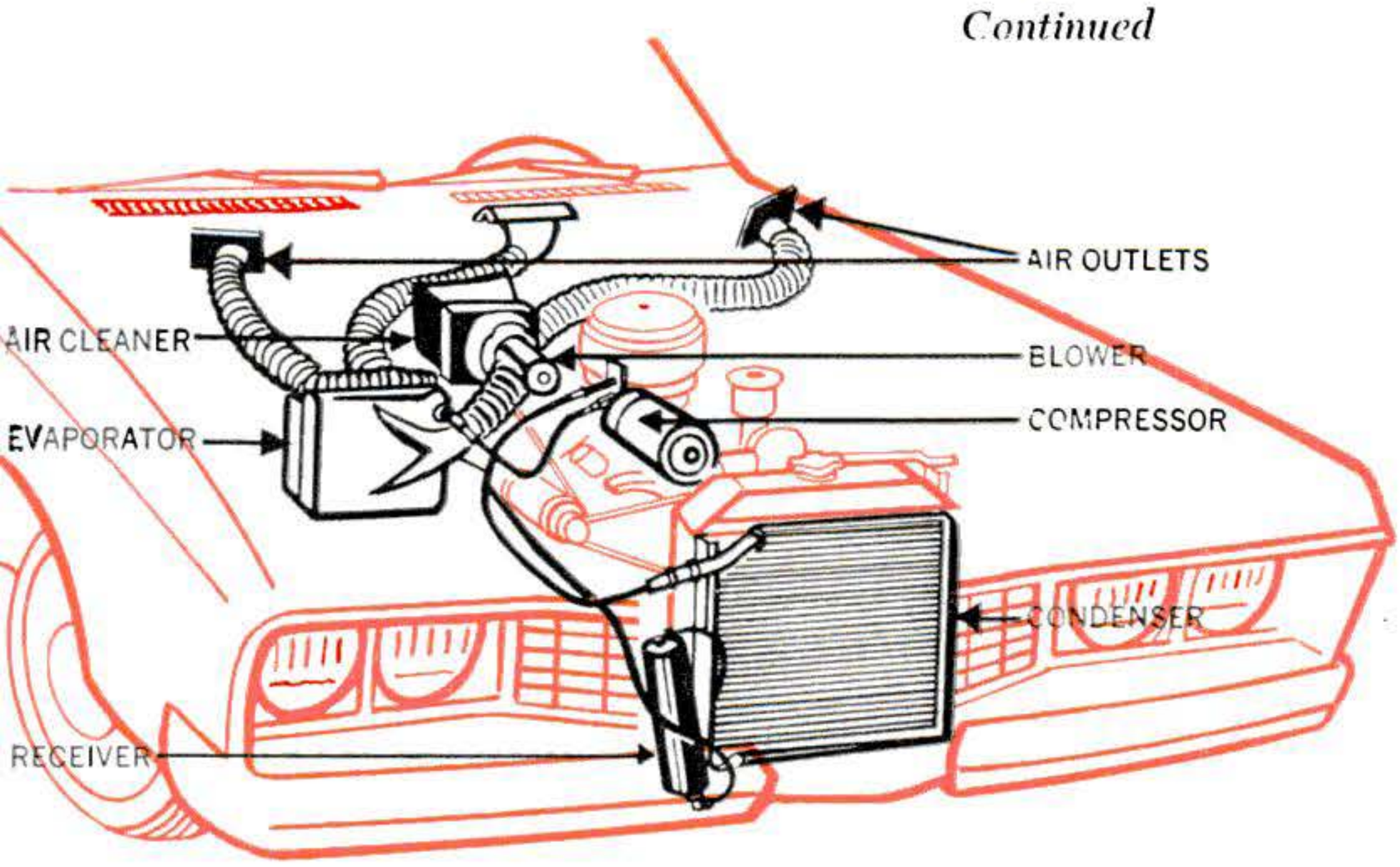


**Air conditioning** throws extra load on cooling system, so cars with factory-installed A/C have larger radiator and higher-capacity water pump and fan. Condenser is placed in front of main radiator, which then gets heated air, not fresh air, for cooling off engine coolant. Regardless of service and climate, it's important that air-conditioned cars use ethylene-glycol coolant year round at a minimum concentration of 33 percent.



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But there are important jobs for cooling-system chemicals—among them, cleaning and preparing the system for fresh coolant.

Light-duty cleaners should be used when there is some, but not much, evidence of rust, grease, and dirt in the cooling system. They flush out loose particles and dissolve grease.

Heavy-duty cleaners attack and loosen hard rust and other corrosive materials. They contain acids—most often oxalic acid—so after their use the system must be neutralized; any acids remaining in the system can destroy the corrosion inhibitors in the coolant.

## Cooling-System Sealers

Again, there are two types—one for stopping small leaks in the radiator and engine block, and a heavy-duty one for sealing more serious leaks anywhere in the cooling system. Both should be used after the system has been drained and thoroughly flushed and cleaned so they can reach the point of leakage.

Some manufacturers say that sealers don't provide protection against future leaks—the sealants in the compounds are used up in stopping the original leak—and they should be considered as giving only temporary relief.

## Antirust and Pump-Lube Compounds

Used with water as a summer coolant, these do their job well. But never use them as a buffer or replenisher for the coolant correction inhibitors. They will not clean out rust already in the system. When using antirust compounds, the system should be flushed clean of old coolant, rust, grease, and other solids. Then it should be filled to 1½-2 inches below the radiator filler neck and the antirust compound added.

Even if you're the first or second owner of a car, it's your responsibility to see that its cooling system is periodically checked and properly maintained. Read your warranty—especially the section on the owner's responsibility for maintenance. You'll probably find that to keep the warranty active, *you* must take the initiative in having the checking, draining, and maintenance done at the right time. *And*, you pay for the labor, worn replacement parts, and coolant needed to restore the system to peak efficiency.

You can have the work done by the dealer, garage, or service station. Or you can do it yourself—but in that case you must provide evidence that the work was done. PS



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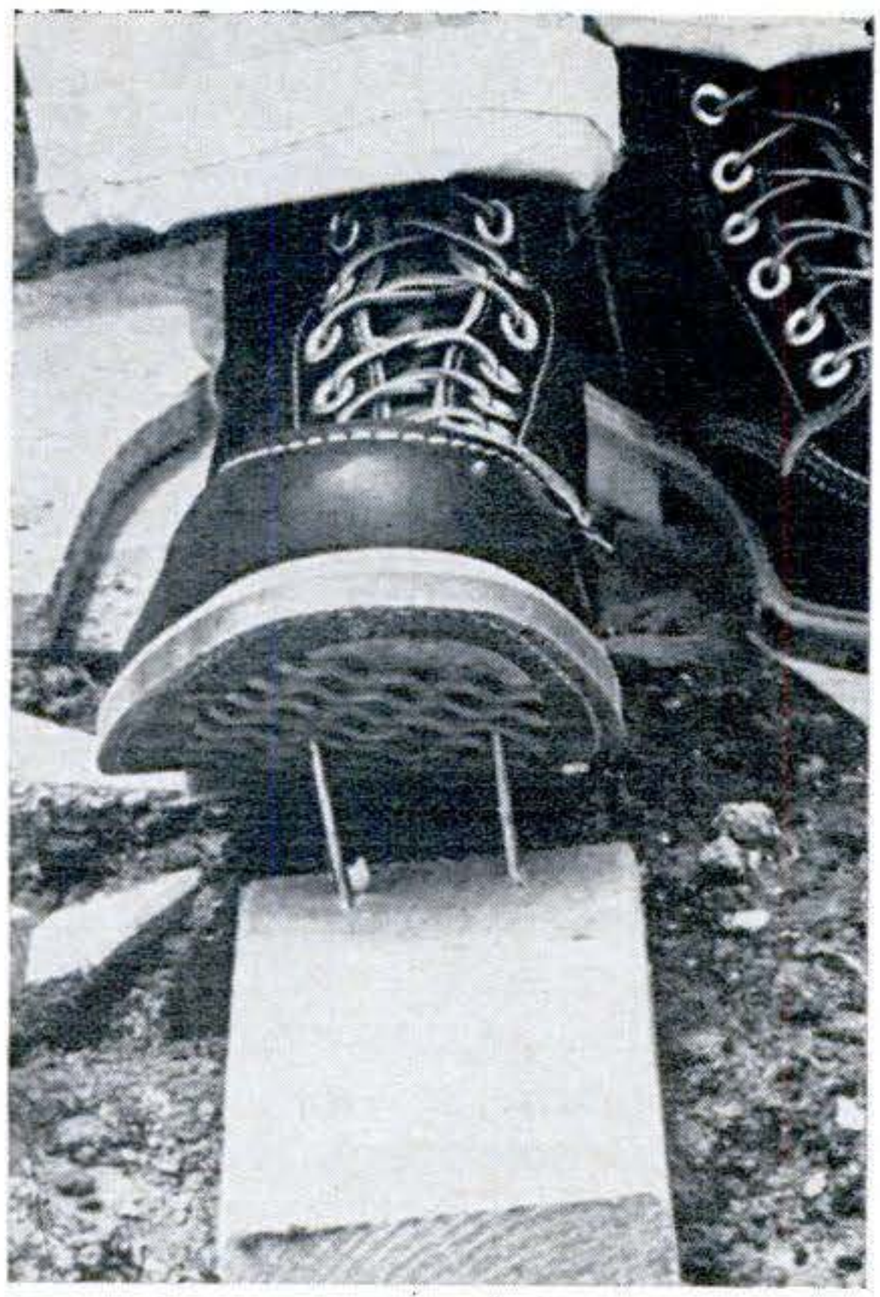
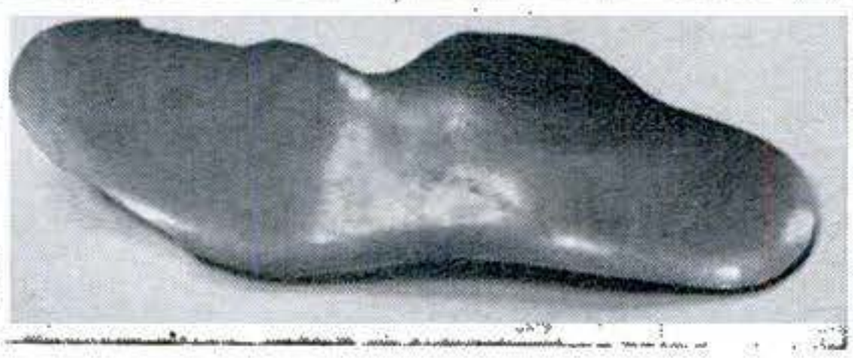
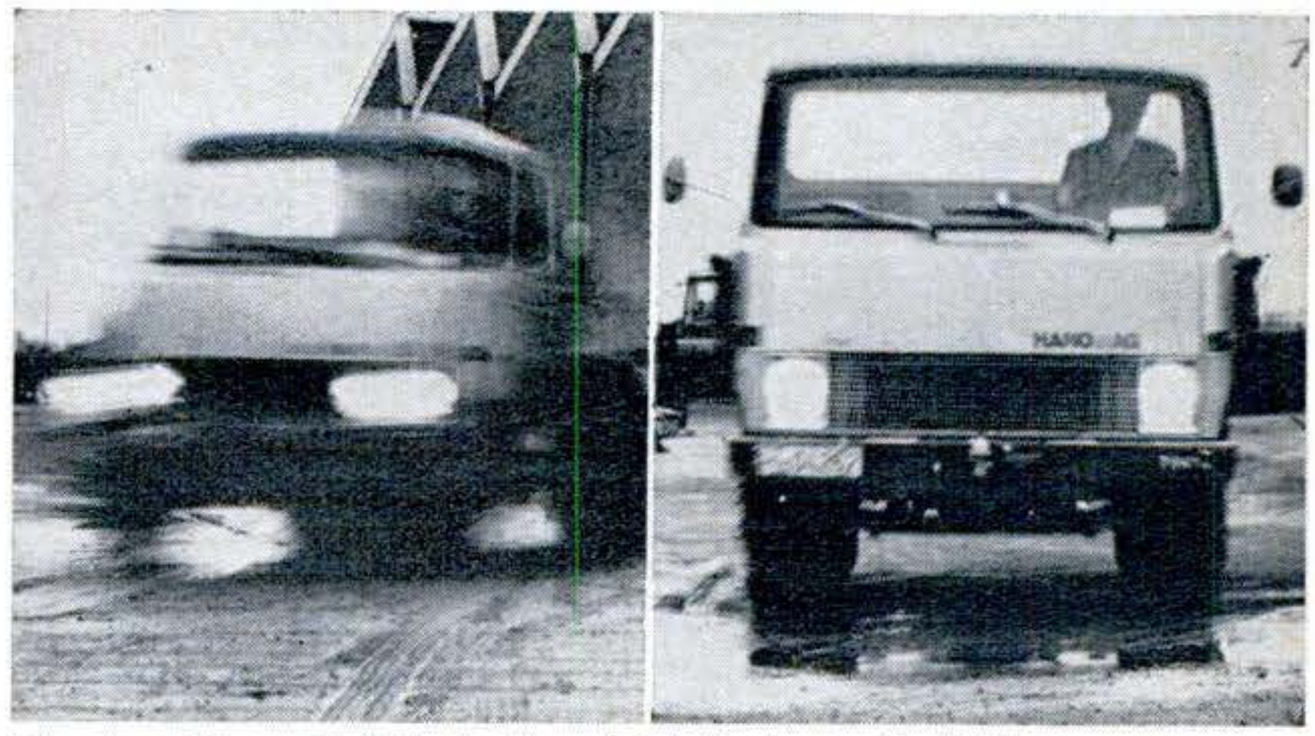




## Now--armor for your feet

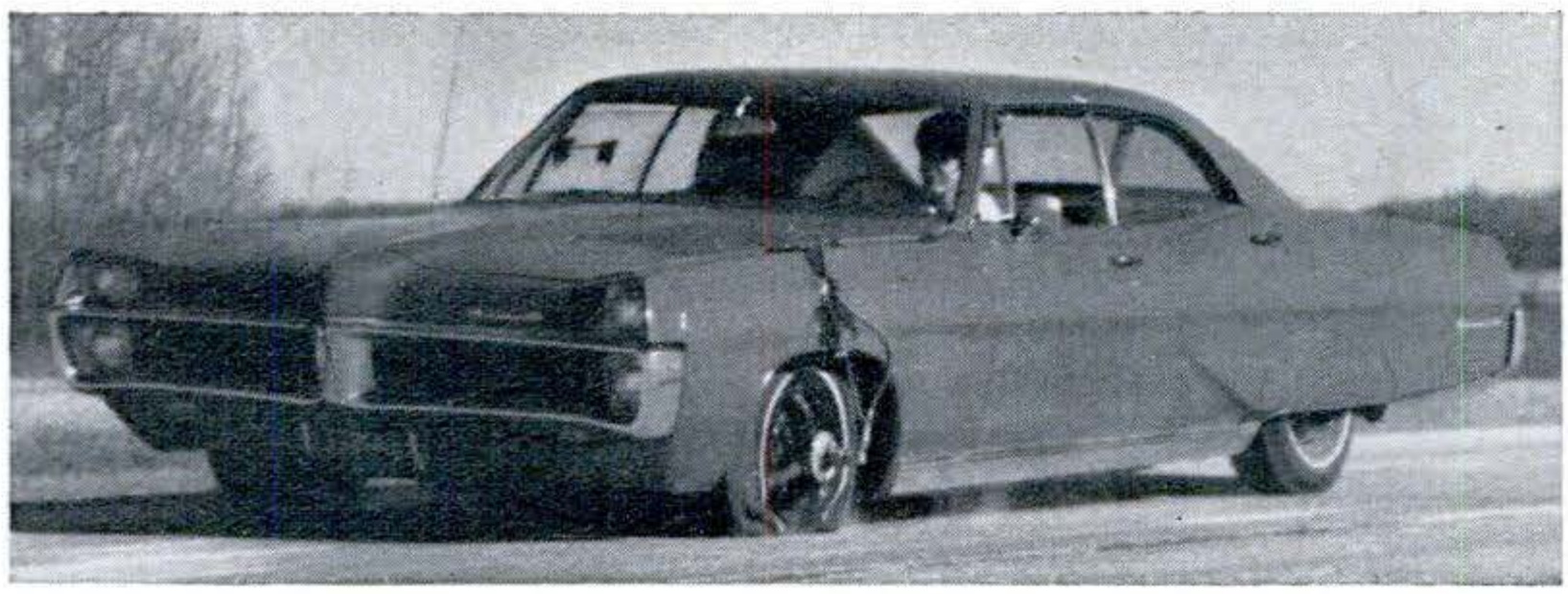
Those nails in the board above won't pierce the man's foot because the inside of the boot is fitted with a paper-thin steel insole (lower photo). The tough insole, made by Armco Steel, is flexible enough to be comfortable to the feet even when you're walking.



**Truck with antiskid device** (right) doesn't skid on wet pavement, but truck without it slides when brakes are applied.

## Device releases brakes to prevent skidding

A new German antiskid regulator proved its value in the test above. The truck without it, at left, skidded when brakes were applied. The truck at right, equipped with the device, rode stably. A sensor (lower photo) detects wheel slippage and signals a control unit to release pressure on wheel cylinders, allowing the wheel to roll. The cycle is repeated intermittently as often as necessary.



## Flat tire—on order—helps train drivers

Here's a switch! GM has developed a gadget that depresses a tire valve on command to flatten tires. Reason: so drivers can learn to cope with a flat in a moving car. The tire can be reinflated from a tank in the car to restage the experiment. GM will provide free drawings of the device for school driving courses.

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# Now They're Printing TRANSISTORS

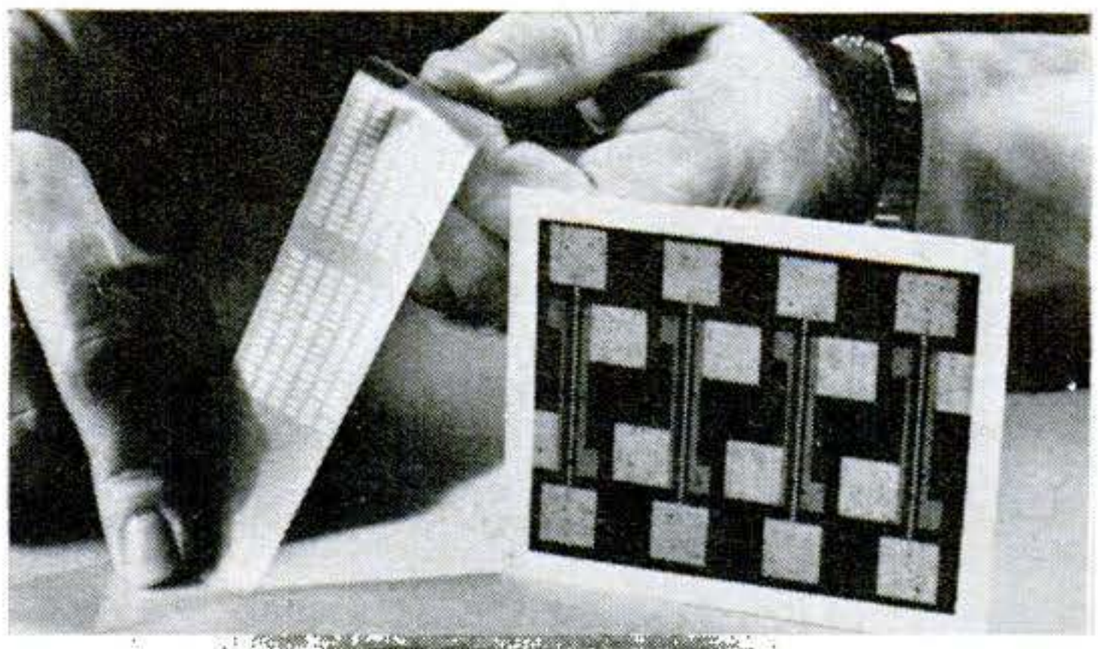
**Some 100 printed transistors** decorate corner of playing card —a demonstration of new process that forms semiconductors and circuits on any material.

By W. STEVENSON BACON

Someday soon you may be able to buy a pad of operating electronic circuits just the way you now buy a pad of paper. On its pages will be printed amplifiers, radio receivers, computer circuitry, oscillators—anything you can name. They'll be so inexpensive you'll be able to tear them out, use them, and junk them.

It's made possible by a method of printing transistors on paper, film, plastic, foil, and many other materials. Developed by Westinghouse, the process is unbelievably simple and economical.

The art of depositing passive thin-film components (resistors, capacitors, and interconnects, for example) is well known. Design an automatic circuit-printing machine to deposit both active (transistors) and passive components and you can turn out circuits in continuous rolls



**Transistors by the yard,** hot off the printing press, are inspected by Westinghouse scientists. The two arrays of semiconductors at right (inset) total 1,316 transistors, some of which are shown in enlarged photomicrograph. Cage-like apparatus below is printing press that stencils thin-film transistors on paper, film, foil. They're flexible but durable.

**Flexible circuits printed by machine on paper, aluminum foil, or film may make possible cheap, disposable radios, hi-fi's, and many other electronic devices**

# ON PAPER!

**Phonograph uses an amplifier** (in model's hand) printed on kitchen foil. In addition to making cheap electronic devices, paper circuits may be printed in books, on credit cards and documents.

for just pennies. Here are only a few of the possibilities:

- Credit and data cards, documents, checks, and other papers with flexible printed-component circuits will help speed identification and processing.
- Revolutionary new medical devices that can be implanted in the body will, for the first time, become really practical.
- A narrow-band TV system that can operate over ordinary telephone lines could become a reality. Such a project is now under way.
- Textbooks and teaching aids, toys, hobby kits, novelties will be based on flexible circuits.

**How it's done.** Thin-film components are made in a vacuum chamber by vaporizing conductors and other materials and then depositing them in layers on an ultrasmooth base. Thin-film transistors, a relatively recent development, go a step further. A sandwich of metals, insulators and semiconductors is laid down in several steps.

Until recently, it was thought that the base had to be an expensive, polished insulating material such as sapphire, quartz, or glass.

What is new is that Westinghouse researchers, headed by Drs. T. P. Brody and Derrick J. Page, have discovered that transistors and other components can be deposited on almost anything. Another first: By using a stenciling method, they deposit hundreds of transistors simultaneously with a single "pump-down" of a vacuum chamber. Formerly it was necessary to deposit each transistor layer separately, pumping out each time.

**Printing press for circuits.** So simple is the new process that it should lend itself to automation—machines that automatically turn out millions of circuits a year. According to Dr. Brody, such a machine would wind a roll of tape through a printing station, a testing station, and an encapsulating station, and onto a takeup roll—just like a movie camera.

At the printing station, transistors would be formed by depositing on the tape, in sequence, layers of gold, tellurium (the semiconductor), glass, and aluminum. Passive components would be similarly formed.

After the circuits were tested, they would be sealed with covering tape brought up from another roll, then wound onto a takeup reel. Final step, with the run complete, would be to remove the reel and slice it into individual circuits.

So far, paper transistors have proved versatile and reliable for any device that does not have to operate at high temperature, power, or very-high frequencies. About the size of the crossbar on this letter "t" and much thinner than the layer of ink used to print it, they have been operated for more than 1,000 hours with no measurable loss. They can be bent, twisted, and coiled. Cut them in half, and you have two transistors.



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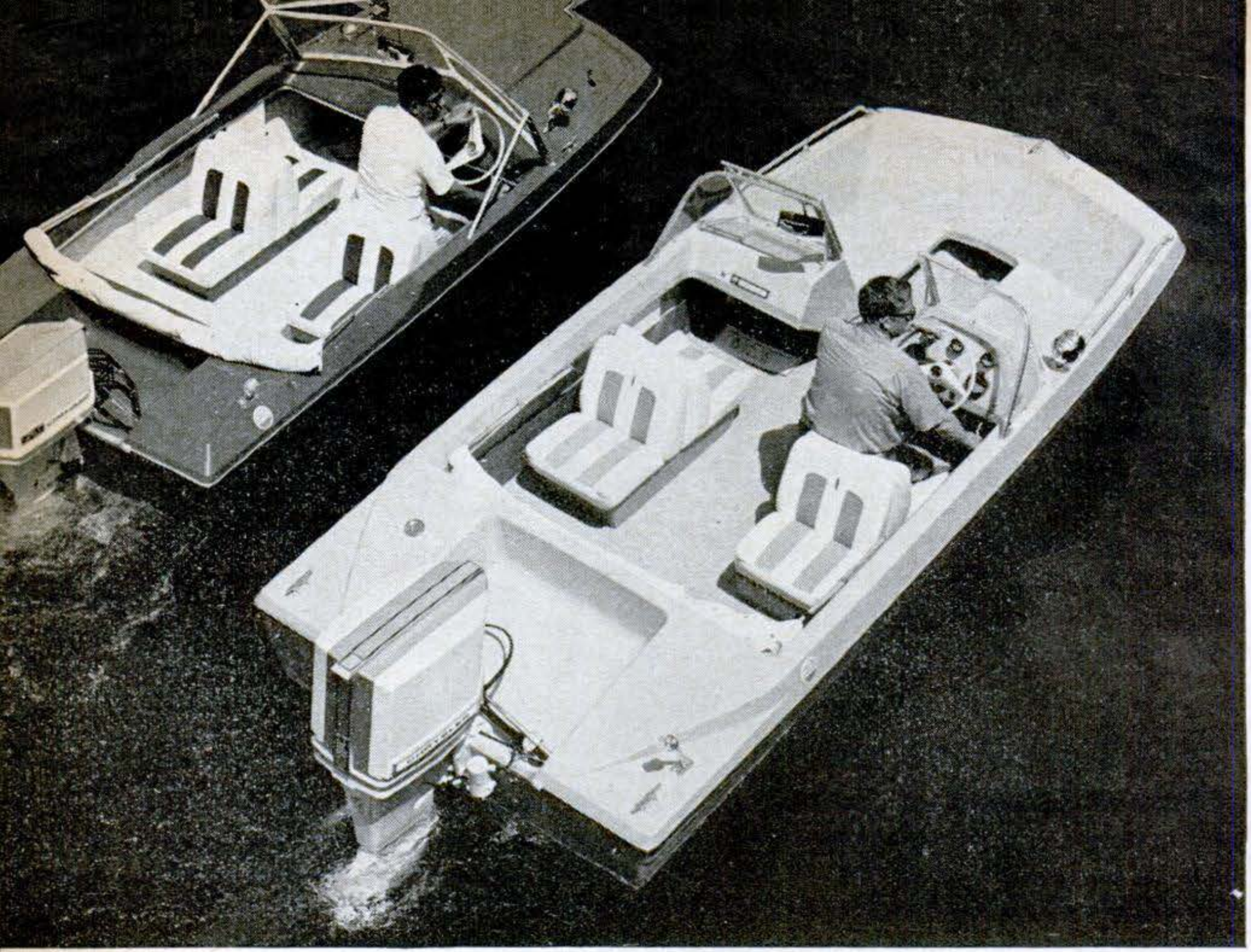

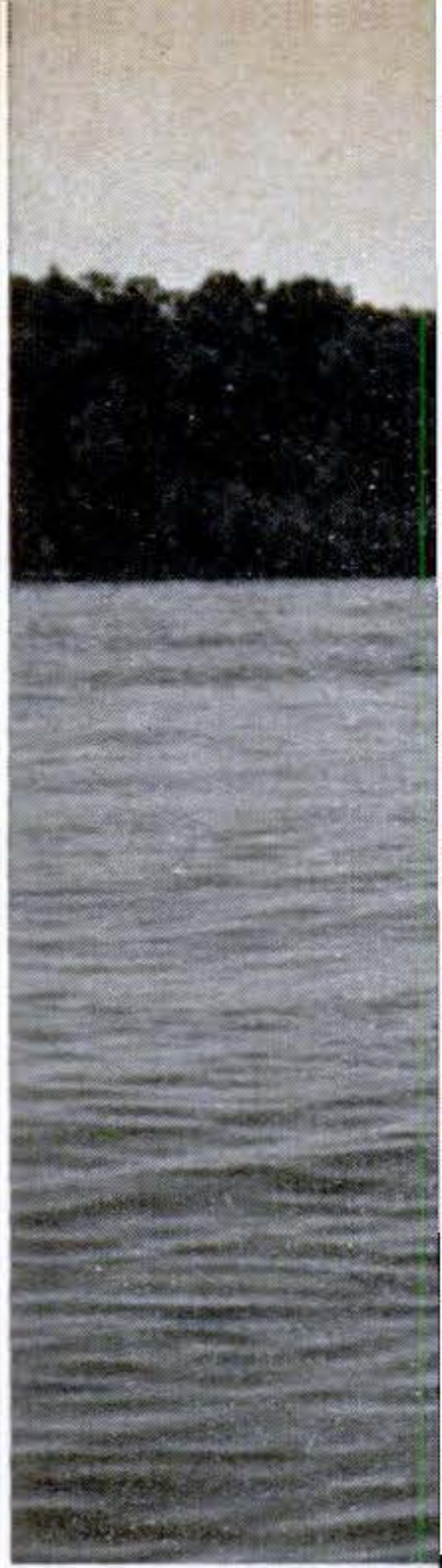

**Two new Chrysler cathedrals** for '69: the Valiant at left, the Sport Fury at right.

# Testing Chrysler's

## There are seven new cathedral hulls for '69. We tested two: the Valiant and Sport Fury

**By JIM ROE**/*PS Boating Editor*

If you're one of the large and growing group of boatmen that likes cathedral hulls, you'd have loved being with us.

We were at the Lodge of the Four Seasons on the shore of the Lake of the Ozarks. The occasion: the unveiling of Chrysler's new line of boats and motors for 1969.

Since a part of the line consists of seven brand-new cathedral-hull boats, the first order of business naturally had to be a series of test runs in them. The new series comes in 14-, 15-, and 16-foot sizes. All are fiberglass. There are two runabouts, a utility, and two bow riders. All of them are designed for outboard power, but the 16-footers also are available with inboard-outdrive power.

For our POPULAR SCIENCE test runs, we chose the Valiant, a 14-footer, and the Sport Fury, a 16-footer. The Valiant was powered with a 55-hp. Chrysler outboard, the 16-foot Sport Fury with a 105-hp. unit.

It was a hot day, and as we proceeded with our test runs, that seemed quite appropriate: We obviously were driving a pair of boats that promised to be hot performers, too.

In spite of its rugged construction, the Sport Fury tips the scales at only 680 pounds, bare-hull weight. So the big 105 made it about the fastest thing on the lake. Since the Lake of the Ozarks has hundreds of intriguing bays, the Sport Fury is a great way to explore a lot of miles of shoreline in a hurry. It's a lively boat, but definitely not overpowered



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**The Sport Fury takes a high jump,** showing off the clean lines of her cathedral hull.

# Racy New Runabouts

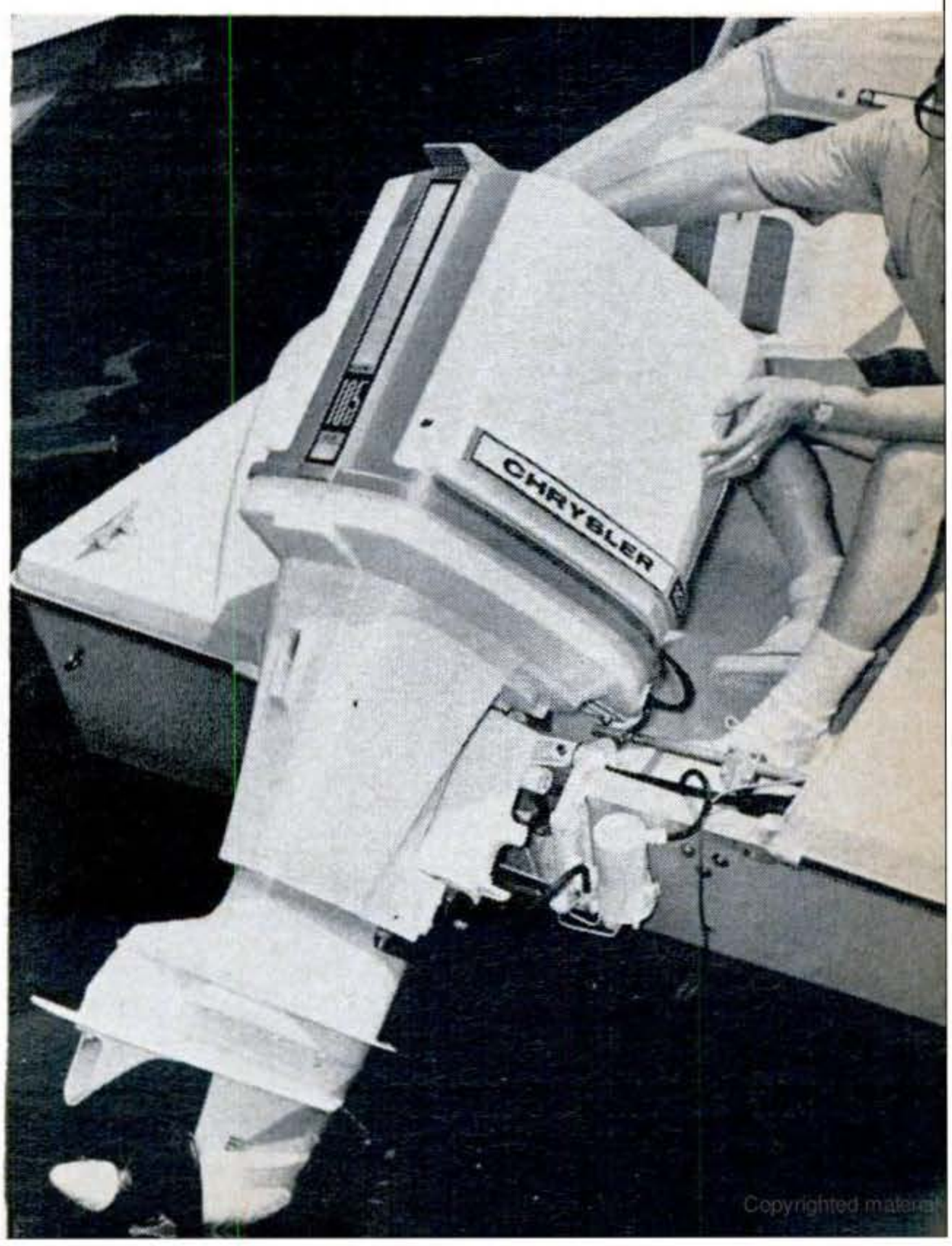
with 105 horses champing at the bit.

Since this is an inland lake with relatively few stretches of long open water, the surface was really too calm for a rough-water test. To simulate rough conditions, I repeatedly crossed the wake of our photo boat, and also tried riding the wake at various foolish angles.

**Taking the rough with aplomb.** Through all of these maneuvers, both the Sport Fury and the Valiant took exceedingly good care of themselves. They showed no tendency to fall off the crest of a wake or to pound excessively when crossing wakes at high speed.

There is only one maneuver about which I would caution you when operating either of these boats: Get the feel of their high-speed turning ability before you

*Continued*




**Maximum rated outboard horsepower** for the Sport Fury is 105. This big Chrysler motor gave power to spare, but felt comfortable and maneuverable on the 680-pound boat.



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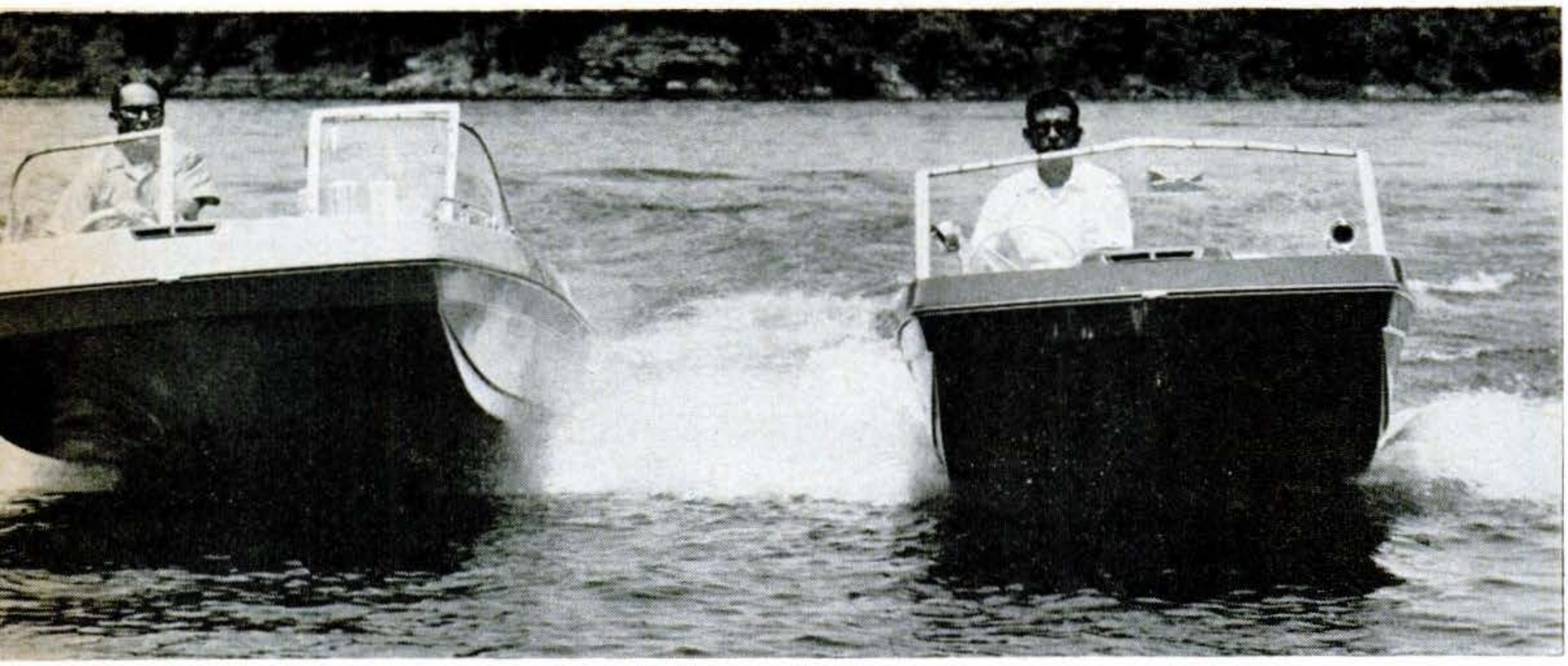

**Big brother and little brother**—the 16-foot Sport Fury on the left and the 14-foot Valiant on the right—show the same clean entry characteristics. New cathedral hulls give soft ride, good stability.

## Chrysler Runabout Specifications

| | Valiant | Sport Fury |
|---|---|---|
| Length | 14'1" | 16'2" |
| Beam | 67" | 76" |
| Max. depth | 28" | 30½" |
| Approx. weight without motor | 475 lb. | 680 lb. |
| Max. hp. | 55 | 105 |
| Outboard shaft | Long | Long |
| Load capacity | 1,488 lb. | 2,083 lb. |
| Cubic footage* | 127 | 178 |

*Computed with Boating Industry Assn. formula

**Control console** on the Sport Fury is well equipped and handy. Tachometer, speedometer, power-tilt control, and other standard instruments for the 105-hp. outboard are well grouped and very easy to read.

make fancy passes at solid objects. While the Chrysler Commando I tested in Florida last winter turned corners at high speed as if on rails, both the Valiant and the Sport Fury tended to slip just a little bit before they made the turn. But it's not a serious problem, and general turning characteristics were good.

One thing you will particularly like about these new Chrysler cathedrals is the workmanship. The fiberglass texture and color is good, and corners are rounded and well-smoothed. Gunwale surfaces are textured to give your feet a good grip even when the surface is wet. Instrumentation, seating, and side storage compartments are nicely engineered, just as you have come to expect in all boats of this company.

**A soft, smooth ride.** Both of the new craft displayed the typical good driving characteristics of a cathedral-hull design. The tunnels of the hull create a cushion that helps provide a softer, smoother ride. In addition, the '69 Chrysler cathedrals feature a deep, short keel designed to give them directional stability.

All seven of the new boats, along with every other boat in the line, have poured-in polyurethane-foam flotation. The process, called Foam-Pac by Chrysler, sandwiches this absorbing layer of flotation material between the hull and the cockpit floor. It is intended not only to give the hull additional flotation, but also to make for a quieter ride in rough water. A cheerful pair of boats, these two. PS



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## Johnson's Surfer for '69—as much fun as it looks

The Surfer hitches up as many as 210 horses at the stern, adds a walk-through windshield for stand-up fishing in the bow, and gives you 21 feet of usable boat. That's plenty of scope for cruising, fishing, hauling skiers, or stretching out for some lazy sunbathing. Rigged as a big-water fisherman with such equipment as fighting chairs and a radiotelephone, the Johnson boat is fast becoming popular with fishermen who go out after the big ones on the Great Lakes.

### And still they come: Two more 1969 outboards

Both seagoing power packages at right are from Montgomery Ward. At top is a new 55-hp. two-cylinder outboard with 44.7-cubic-inch displacement. It's available with manual or electric start and has a safety lock that prevents it from starting when not in neutral. The outboard in the lower photo is a 9.2-hp. electric model. It has full shift control of neutral, forward, and reverse, comes with a choice of manual or electric start.

### Every inch of space goes to work

This is the new Minikai—a 17-footer of "Quadralift" deep-V tri-hull design. Grilled fiberglass bracing, with built-in standard foam flotation, eliminates rot-prone wood reinforcement in the double bottom. Notice that lounge deck up forward—perfect for casting, sunning, or as a diving platform. Winner Boats, Inc., Dixon, Tenn. 37055.

### Duck blind floats to birds

Here's a duck blind designed to fit 14-foot johnboats. Zippered openings fore and aft let you operate the boat with the blind in place; side openings allow exit and return of a retriever. There's even a boarding rig to give the dog footing while still in the water. Fisher Marine, Box 398, West Point, Miss. 39773, makes the floating blind.

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# Can This Piston Ring Cut Smog Emissions?

**This head-land piston ring promises to reduce unburned hydrocarbons in the exhaust and blow-by while actually increasing power output**

By JAN P. NORBYE / *PS Automotive Editor*

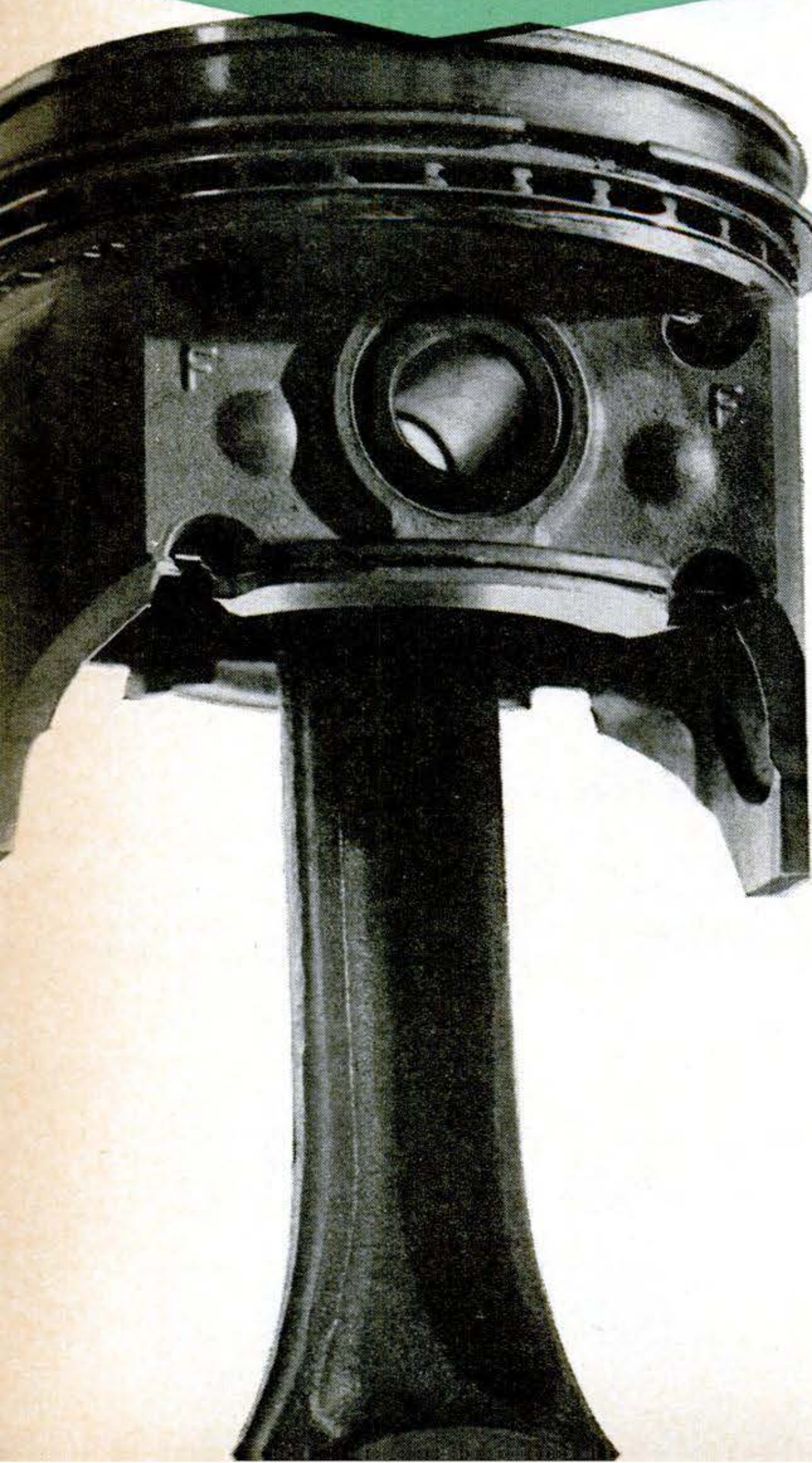
Three years and $250,000 ago, Gordon Reynolds and his firm, the Sealed Power Corp. of Muskegon, Mich., began their frontal assault on the problem of exhaust emissions. The result is the head-land piston ring, which, says Reynolds, will reduce unburned hydrocarbons in the exhaust by 15 percent, cut blow-by gas volume in half—and boost horsepower by 10 percent.

It's part of the battle to reduce motor-vehicle emissions and meet the standards set by the nation's air-pollution agencies and the federal government. So far, automotive engineers have succeeded in meeting these standards.

First came positive crankcase ventilation, which reroutes blow-by gases (combustion products that have sneaked past the pistons and contaminated the air in the crankcase) back to the air cleaner and sends them through the engine again.

Then came the air-injection reactor systems, using an air pump to inject a blast of fresh air into the exhaust ports and help burn up any unused mixture.

But these two devices eliminate the symptoms of inefficient operation without attacking the problem at its source. Detroit has come up with some devices that are directed at reducing emissions by improving the engine's thermal efficiency: Chrysler's Cleaner Air System (CAS); General Motors' Controlled Com-



**New head-land piston ring** (shown at left) rides in a groove only 1/16 inch below the piston head and seals off the head-land area. A conventional ring (photo below) rides 3/8 to 1/2 inch below the head.

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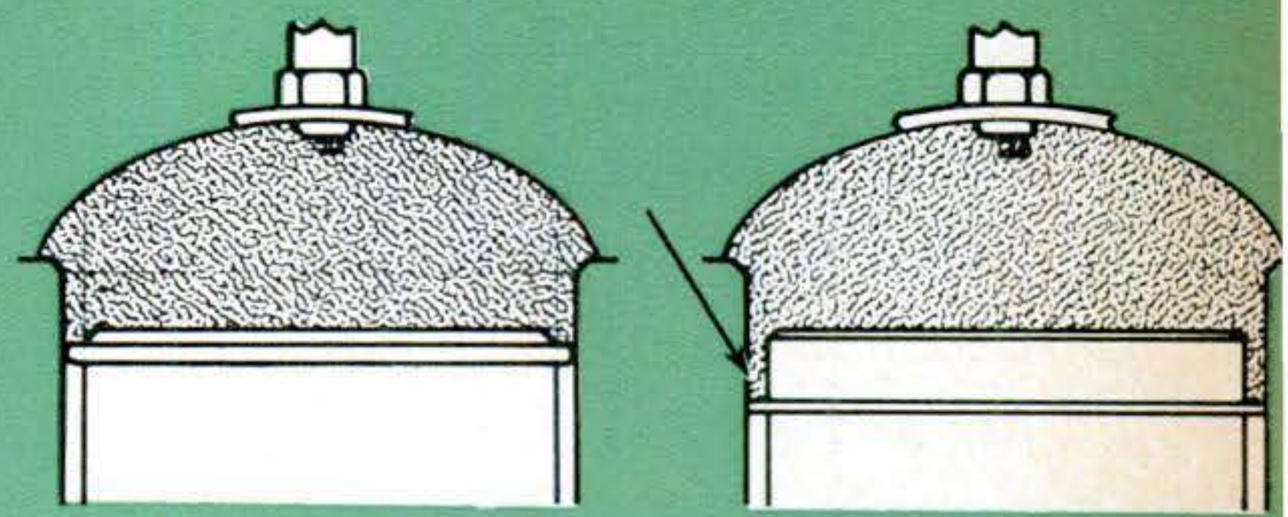
bustion System (CCS); and Ford's Improved Combustion Process (IMCO). Independent inventors are coming up with ideas, too—like the head-land piston ring.

How does the ring boost power? Blow-by is a power leak; by reducing it, the efficiency of the combustion process is improved. The head-land ring works this magic by being placed almost flush with the piston head in a groove only 1/16 inch down from the top. In today's engines the top compression ring is located between 3/8 inch and 1/2 inch from the piston head. The lower the top compression ring, the greater the volume of fuel mixture trapped alongside the piston-head land during the operation cycle. Fresh mixture trapped in this area will be pumped out with the exhaust gases—unburned. The head-land ring seals off the area to the fresh mixture and this source of air pollution is eliminated.

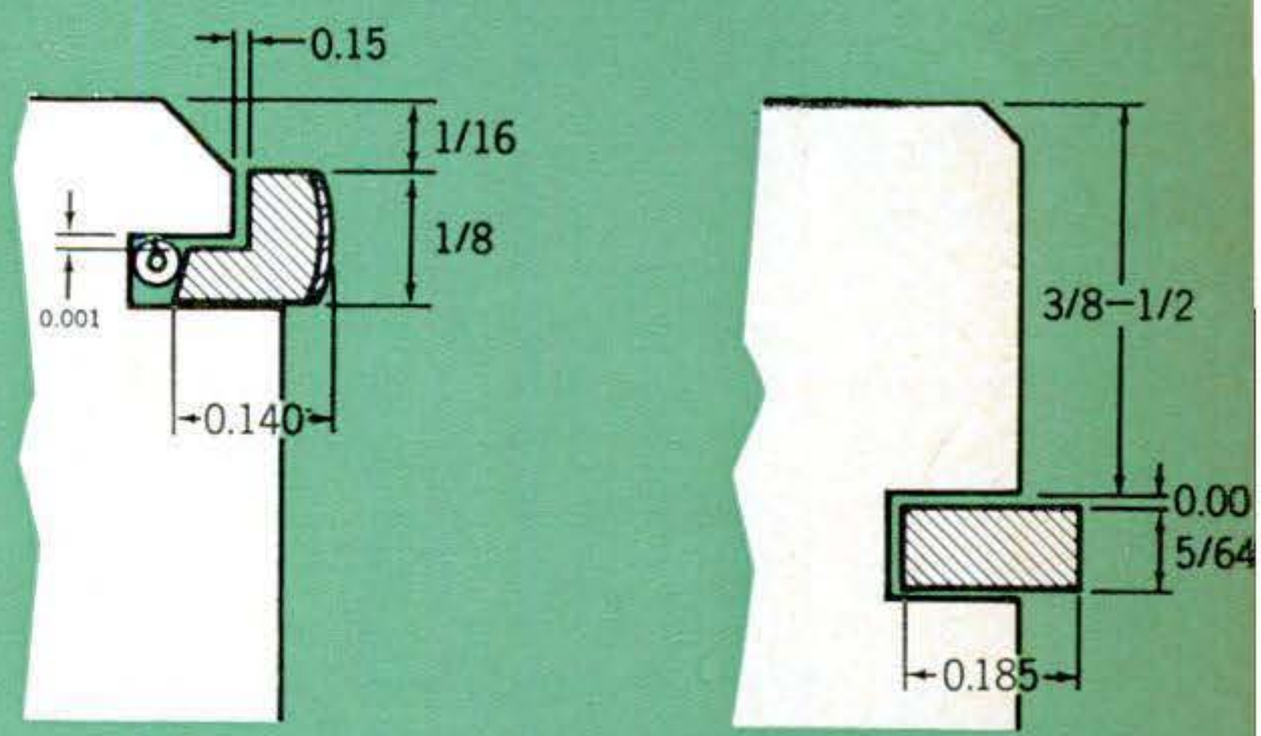
The reduction in blow-by gases is a result of the effective sealing provided by the head-land ring. It's not a spring-type ring (although it has a normal clearance gap) that operates under tension; it relies solely on gas pressure in the combustion chamber to effect a seal. Gas gets behind the ring's L-shaped profile and presses it against the cylinder bore. Gas loading is almost instantaneous.

To ensure adequate sealing in the absence of gas pressure, there is a stainless-steel coil-wire expander behind the ring. The ring itself has no internal stresses and can therefore withstand higher temperatures. Present compression rings are not placed higher up because they'll break, if brought that close to the combustion chamber.

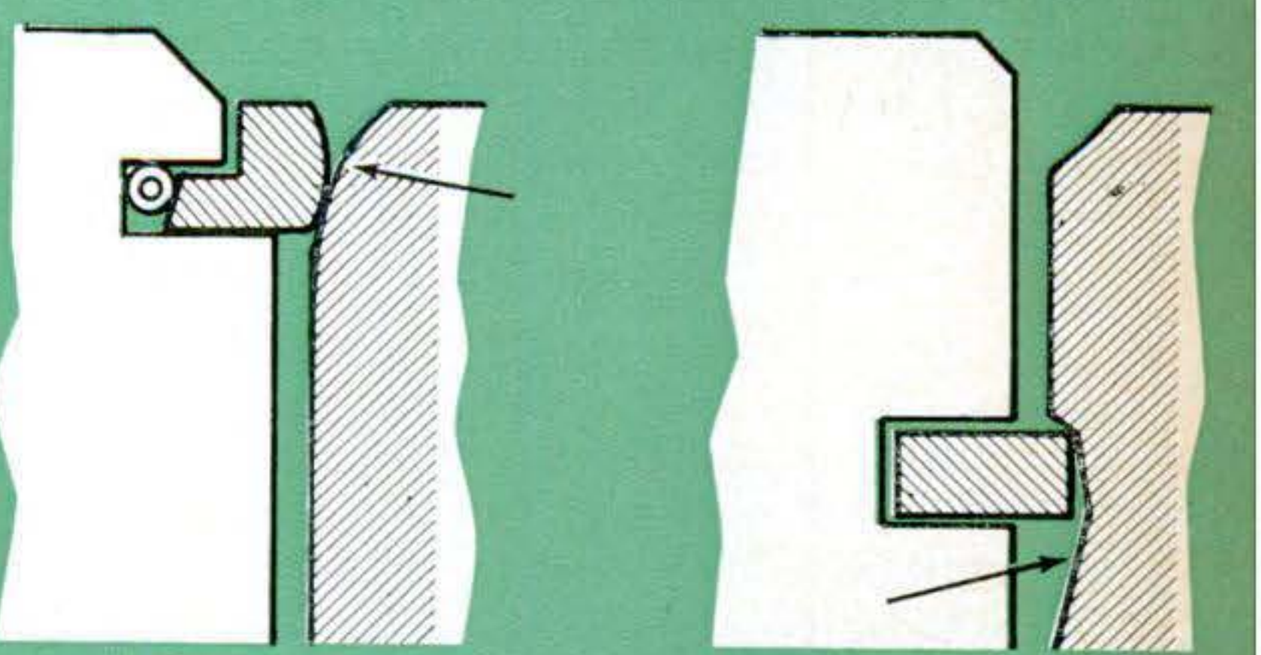
It wasn't possible to get the head-land ring (and pistons designed for it) into production in time for the '69 models, but chances are it will be used on some '70 cars. All four of Detroit's auto makers are running tests on the ring right now.



**Fuel vapors are confined** to the combustion chamber with head-land ring (left). Conventional ring (right) provides an annular area between piston and cylinder bore where unburned mixture can collect.




**Gas pressure** from the combustion chamber gets behind the L-shaped profile of the head-land ring (left) to make effective seal. Without gas pressure, a wire spring in the ring groove presses the ring out.



**Radiused face on head-land ring** assures smooth bore wear without ridges, and prevents buildup of abrasive combustion deposits. Under pressure reversals, ring face can twist without going on edge.

**Cylinder-bore marking** and combustion deposits are reduced by the new system. Cylinder below at right ran 150 hours with conventional piston and rings; one at left ran for same period with head-land ring.

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# CRAZY CUBES

**These baffling puzzles, long-time favorites dressed up in new guises, are delighting millions**

By PAUL WAHL

These wild little puzzles can blow your mind! They look innocent enough: brightly colored plastic blocks neatly stacked and sealed in a wrapper. In one version, Parker Brothers' Instant Insanity, four colors show up on each side of the stack of four blocks. You're to open the package, mix up the blocks and then restack them so there are again four different colors on each side. Child's play? Well, maybe.

Before you mix them up, take a good long look at the properly stacked blocks. You may never see them like that again—even though it can be done.

KMS Industries' Nice Cubes present the same problem. Here, squares in four different colors are painted on the sides of transparent plastic blocks. They're doubly confusing, for you can see right through them.

There is only one solution to Instant Insanity and Nice Cubes, and the chance of success in random assembly has been calculated at one in 41,472. With perseverance (and luck) you might do it by trial and error. You can try a mathematical attack, but deductive reasoning is the fastest route to a solution.

Yet another variation of the same general theme of cube games is Mental Blocks, also made by KMS Industries. You might use this one as your graduate course in puzzle-solving, for eight different cubes are involved. Each cube contains horizontal and vertical rods in three different colors. The objective: to line up vertical and horizontal rods—*and* match colors.

Recent studies done with Instant Insanity seem to indicate that children in the 8-12 age group solve it in the least time—often to the chagrin of parents who have struggled long and unsuccessfully. These kids take an average of about half an hour. It has been done in three minutes. Yet one teacher, with a master's degree in math, gave up after 40 hours of work on the puzzle.

Highly educated adults seem to have the most trouble, although there are exceptions: people with a real talent for creative problem-solving.

Instant Insanity and Nice Cubes are actually reincarnations of a very old puzzle. Other generations have known it as The Great Tantalizer and The Katzenjammer (German for hangover). They're available where games are sold and cost about a dollar. If you wish, you can make your own (see right). Try them and experience real fun and frustration.



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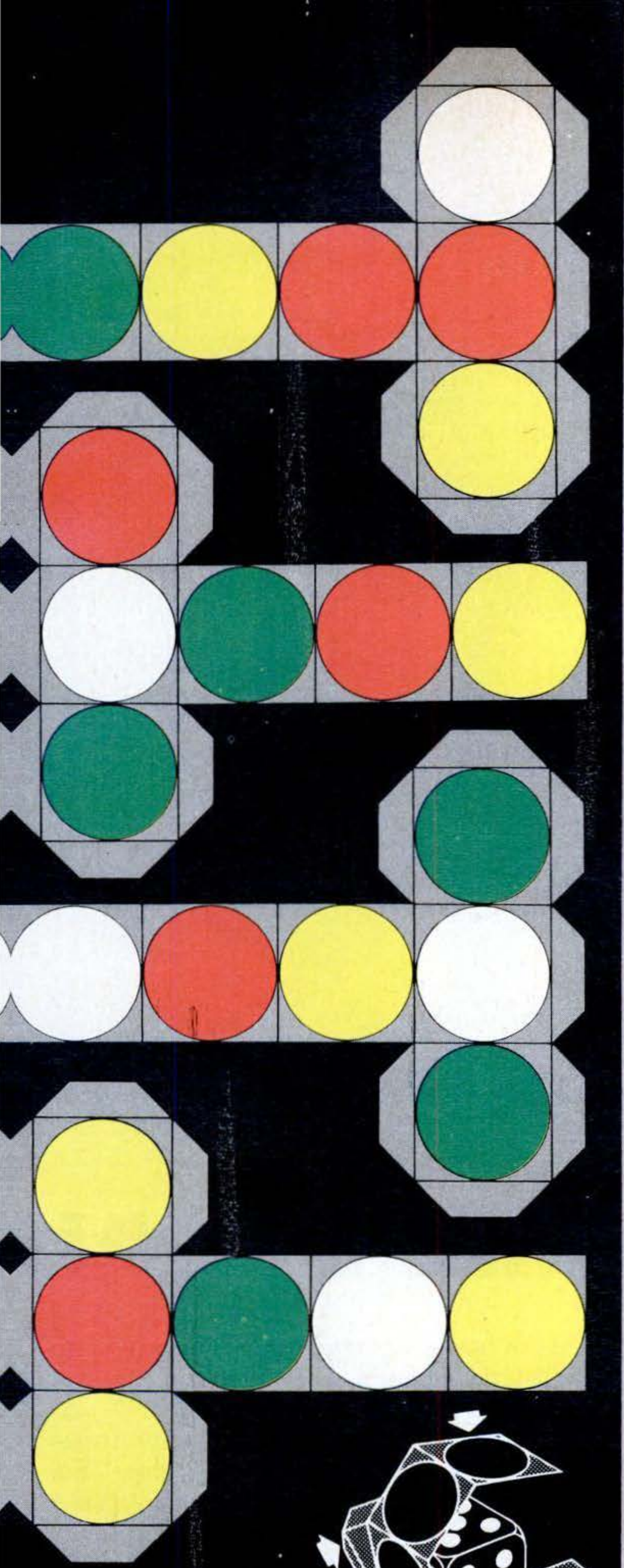
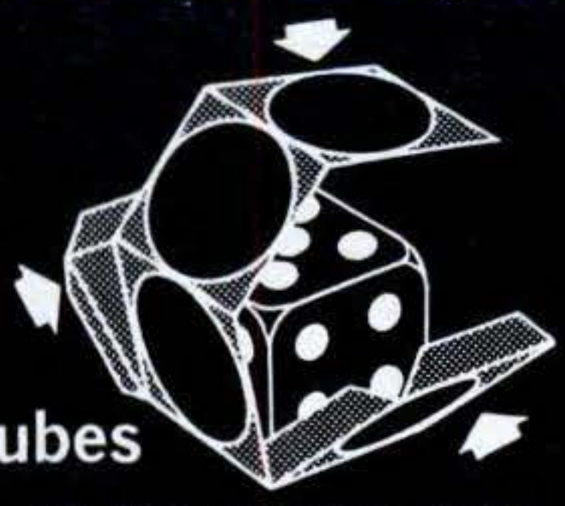
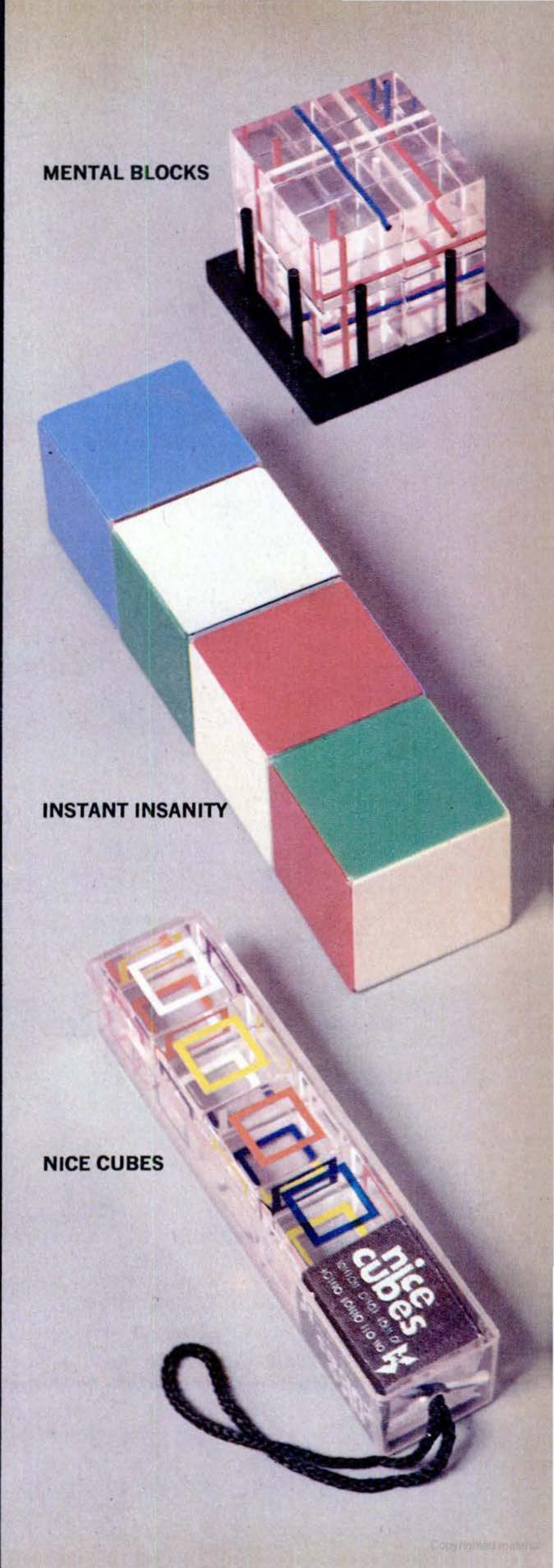




## Make your own cubes

**Here's the PS version** of the popular cube games, and you can make it yourself. Simply cut out the four forms containing the colored circles. Fold them to make cubes, using dice to support them and gluing tabs in place. If you prefer, you can eliminate dice: Paste forms to light cardboard or construction paper to stiffen them, fold into cubes, and glue.




MENTAL BLOCKS

INSTANT INSANITY

NICE CUBES

## PS EXCLUSIVE!

# You Can Build the Air

By HARRY WICKS
PHOTOS BY BILL MORRIS

Recently, when photos of a just-completed dormitory — the latest addition to the Air Force Academy at Colorado Springs — made the editorial rounds at PS, opinion was unanimous that two of the facilities' attributes were striking. First, the rooms are designed for fast cleanup and maintenance, leaving the cadets with more time for out-of-classroom study. Second, although the furniture is equally easy to maintain, it's extremely good-looking.

Just how important *is* environment to good study habits, I wondered? Lt. Gen. Thomas Moorman, the Academy's Superintendent, feels that "a good study atmosphere is conducive to good grades." So, when the dorm was in the planning stage, all aspects of human behavior were taken into account to assure that the new quarters would "make it possible for members of the cadet wing to maintain a high degree of academic excellence," as the General put it.

To achieve the desired atmosphere, the architects and engineers leaned heavily on experience gained in the original dormitory. Since space was at a permium when



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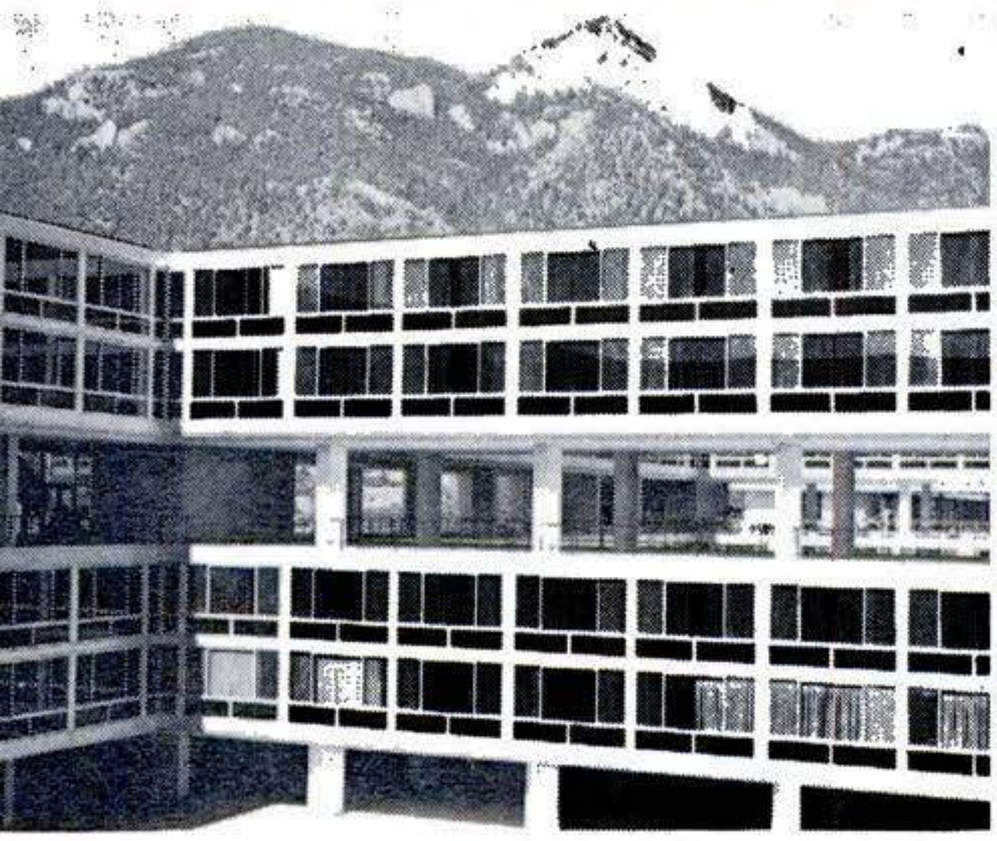
The well-designed furniture in the study rooms of the new cadet quarters (below) prompted PS to ask the Air Force Academy's approval to reproduce the desk in our own shop and publish plans so our readers could do the same. While obtaining permission, we learned some interesting facts about what goes into planning an efficient student environment—facts applicable to home study. As the focal point of all study, this desk is sure to please any student, and it's easy to build following our Lie-Flat Blueprint.

The Editors.

ACADEMY PHOTOS COURTESY U.S. AIR FORCE



# Force Academy Desk

the academy first opened, three cadets were billeted to a room. This proved unsatisfactory. One of the two beds was a double bunk, and it was impossible to provide independent study areas.

**Study environment.** Former Dean of Faculty Brig. Gen. McDermott explained it this way: For most students, the environment for study is affected by three variables—interruptions from visitors and noise, the number of students assigned to a room, and the appearance and layout of the room. The first condition can be controlled by rules and regulations, the other two by planning the study space.

An important part of such planning is

*Continued*

**Before they ever get to fly a plane,** cadets spend long hours piloting a desk. Cadet Quigley (standing), New Caldwell, N.J., and Cadet Swecker, Valley Head, Va., use their desks about four hours a day.

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the choice of furniture. In the case of the new dormitory, nothing was left to chance. Each piece was custom-designed for cadets, and constructed to government specifications.

Since success in school depends largely upon home study habits, PS asked for, and received, full approval for its readers to build a copy of the Academy desk for use in their homes. What better way to encourage a procrastinating student to crack the books? Cooperatively, the Academy supplied the specifications and plans so that the copy could be kept as close to the original as possible.

Built of walnut and aluminum (as are matching chest and bed), the desk is rugged enough for years of service. Judging by its sleek good looks, you would expect it to be tough to build. It's not. It is simply an aluminum frame with end panels and a box-like drawer case.

**The PS twin.** To make it possible to build the desk of materials that are readily available, we've made a few changes. But, as can be seen in the photos, the appearance is barely altered. Overall dimensions are the same. The changes:

- The original specs called for 1¼" aluminum angle, channel, and square tubing. All three are available only through wholesale supply houses at premium prices. Instead, Reynolds do-it-yourself 1" square tubing has been substituted and used throughout the frame.
- The drawer pulls on the original are custom-made ones, so they were changed,

## MATERIALS LIST

**REYNOLDS DO-IT-YOURSELF ALUMINUM**
Frame—6 6' pcs. 1"-square tubing (#4860)
Drawer strips—1 6' pc. ½" angle (#2406)

**TEMPERED HARDBOARD**
Drawer bottoms, dividers—1 pc. ¼"x4'x4'

**PARTICLEBOARD**
Top—1 pc. ¾"x3'x5'

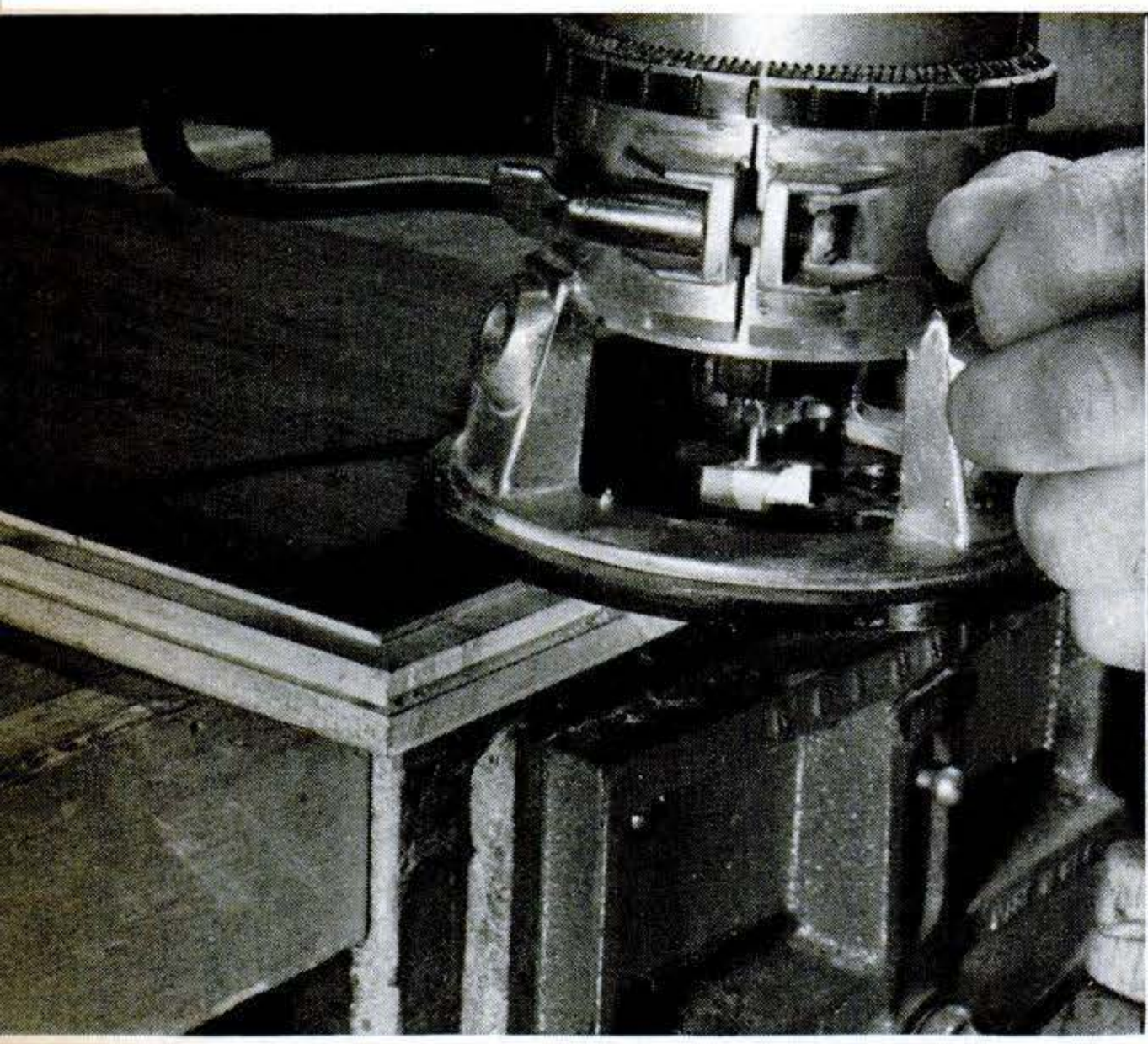
**LUMBER**
Upper drawer—1 pc. pine ½"x4"x6'
Lower drawer—1 pc. pine ½"x8"x6'
Drawer edging, slide front—walnut, 1"x1"x 10'
Filler cleats, plugs, straddle strips—scrap

**PLYWOOD (WALNUT)**
End panels, drawer fronts, case—¾"x4'x8'

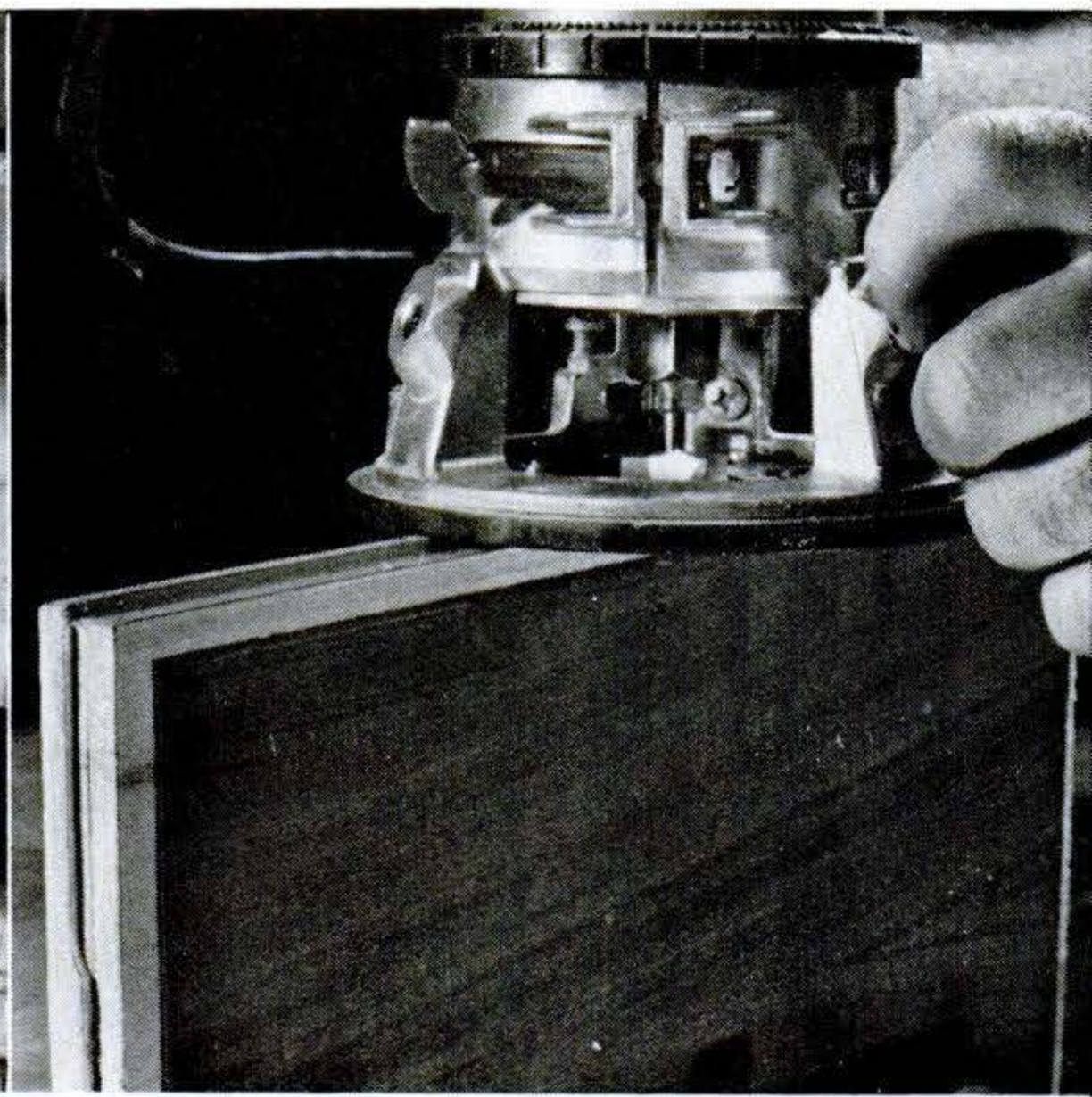
**PLASTIC LAMINATE**
Top—1 sheet, 3'x5' Pionite Alpine White Encore

**HARDWARE**
14 oval-head screws 2¼"-8; 12 F.H. screws 2¼"-8; 32 sheet-metal screws ⅝"-8; 10 R.H. screws ¾"-8; F.H. screws 1¼"-8; and 1½"-8; 4 Domes of Silence 1" diam.; 2 ½" bullet catches; 2 Knape & Vogt #819 flush pulls; 3 pr. Alta glides, 14 1" corner braces

**MISCELLANEOUS**
Aluminum cement or epoxy; 4d finishing nails; 1 qt. contact cement; glue; stain, lacquer; wood plastic or putty stick



**To frame drawer fronts** with recessed angle, first rabbet all four edges, then plough the face (above).



**Make repeat pass on edges,** with router shoe riding high edge to restore diminished width of rabbets.



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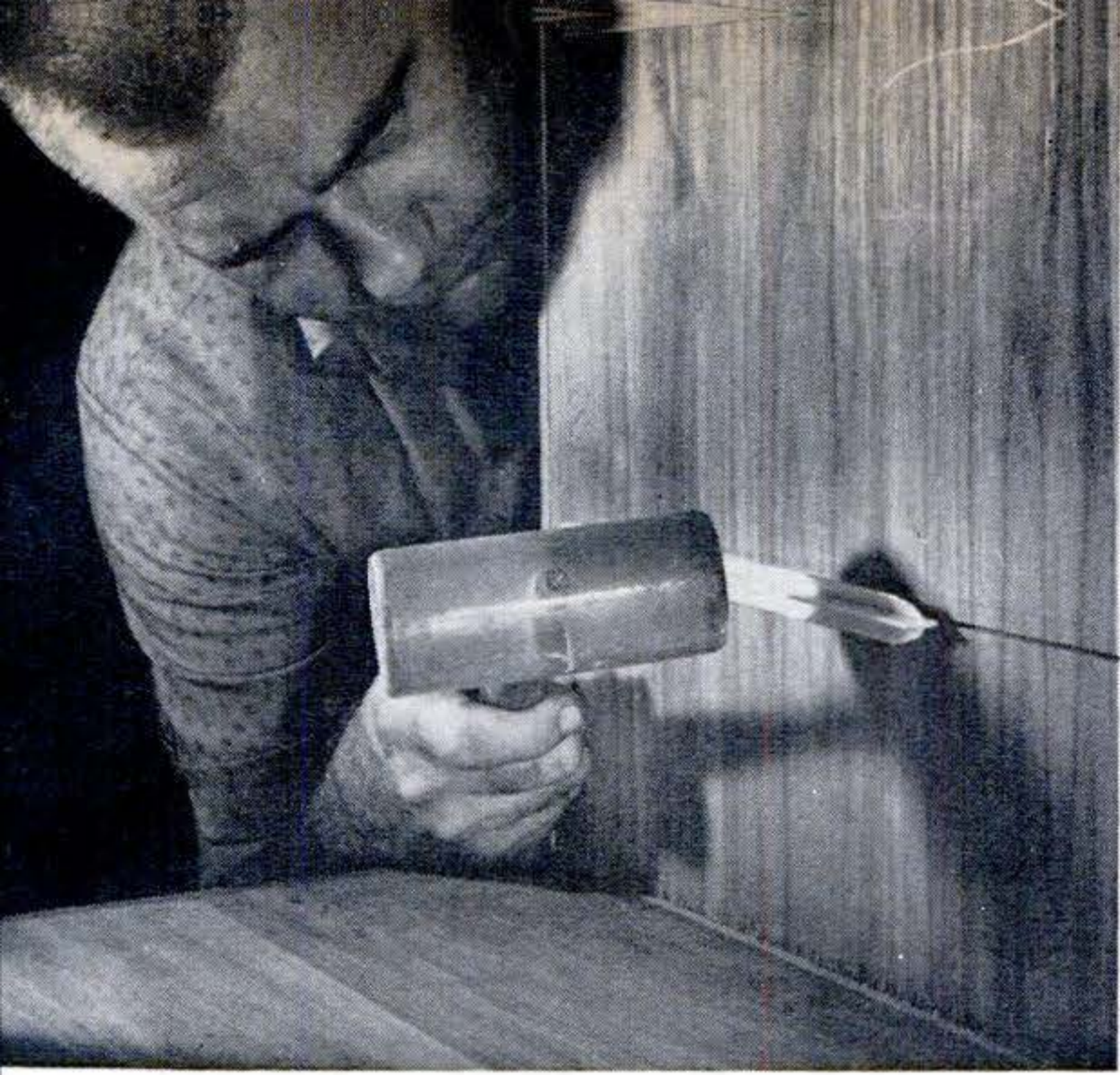
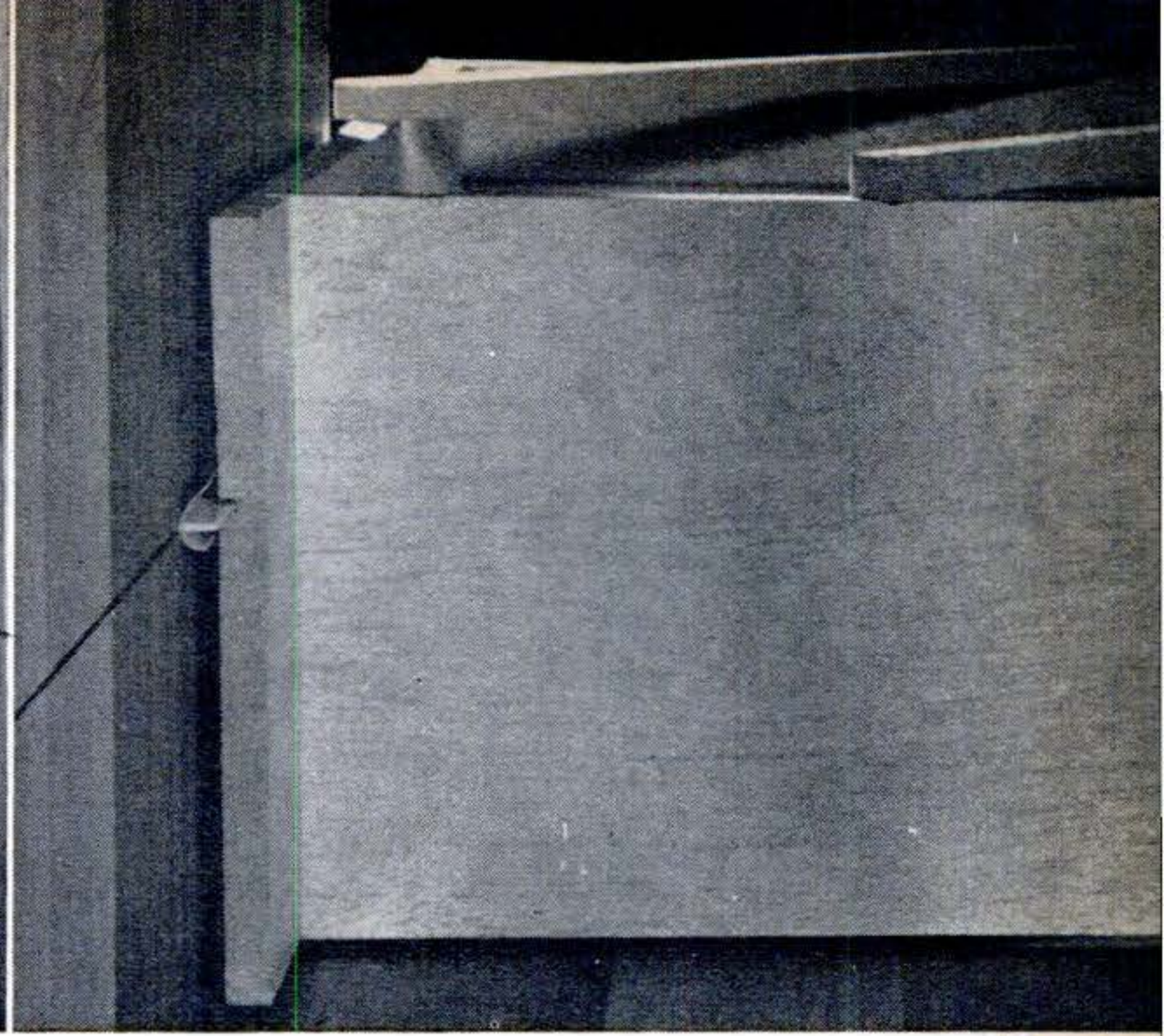


**View from the back** shows Alta drawer glide being tapped into saw kerf. Glide is set in ¾″ from forward edge to allow clearance for drawer front.



**Temporarily assembled drawer** is checked for slide-fit. If tight, front and back can be trimmed. Tacked-on braces keep drawer square during this step.

too. A search turned up Knape and Vogt's flush pulls. Installed, they give the same contemporary or military-chest appearance as those on the Academy desk.

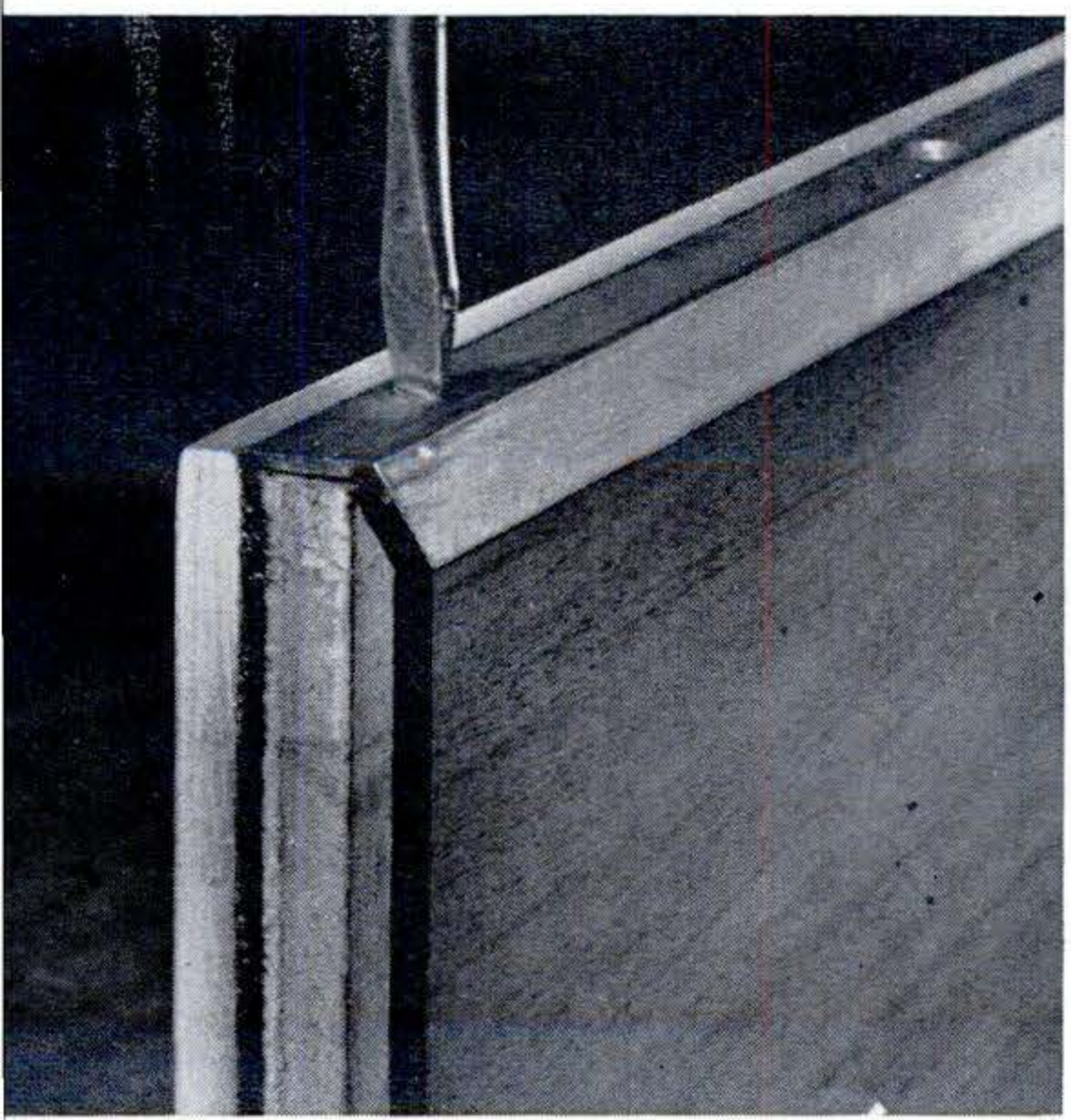
• The invisible welded joints called for in the specs require special equipment and would up the cash outlay about $10. Our wood-plug method holds strongly and uses shop scrap.

**Building the desk.** Start by cutting the aluminum tubing to length and plugging the ends, as shown. To insure neat joints, squirt a bead of aluminum paste (or use aluminum epoxy) on the wood plug before joining. Frame assembly goes easiest if you put the two end sections together first, then join them with the rails and lateral stretcher.

Walnut end panels go in next. Since they just butt the frame, and no gap-hiding moldings are used, cut them carefully. To insure perfect joints, I cut two pieces of plywood slightly oversize and used each frame as a marking template. The panels are held firmly with flathead screws through top and bottom rails only.

Do the top next, starting with the edge strips. Apply the strips at the ends first, then the front and back. Cut the laminate for the top with an ⅛″ overhang on all four sides. After it's bonded, trim the excess with a straight carbide cutter in the router, or with a sharp iron in your block plane. Finish the top by beveling all edges slightly with a smooth file. Attach the top to the frame as shown.

**Making the drawer case.** This rests on the lateral stretcher, and can be butted against either end panel, to suit the user and the location of the desk. To assemble the case, use well-set 4d finishing nails and white glue. Set the nails and fill with wood plastic or a putty stick. *Note:* You must run the slide-holding kerfs in the sides of the case before assembly.



**Mitered angle sets flush** with both face and edge. Cut test-edge first on scrap to judge right depth.

Turn the page for lie-flat blueprint

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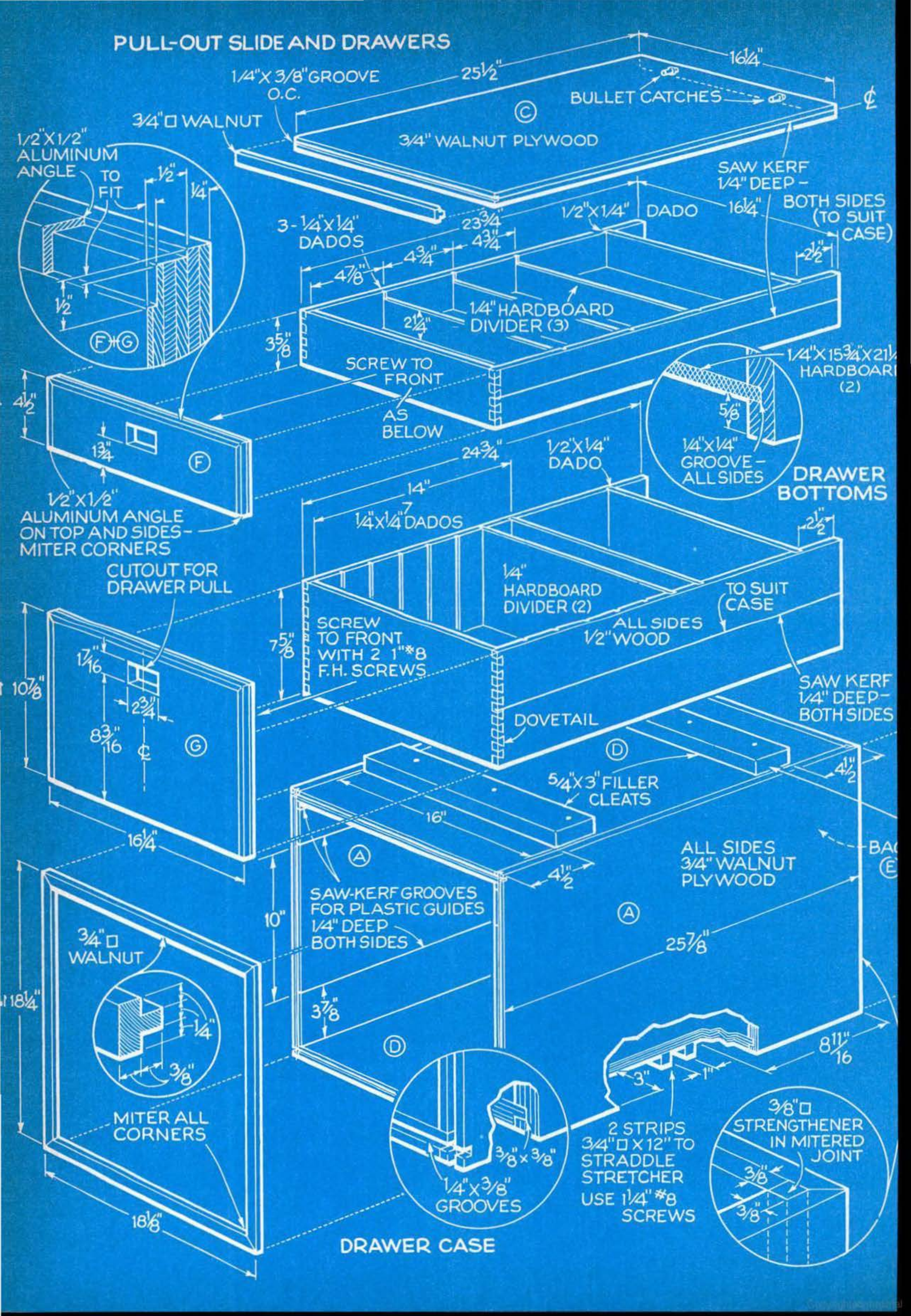
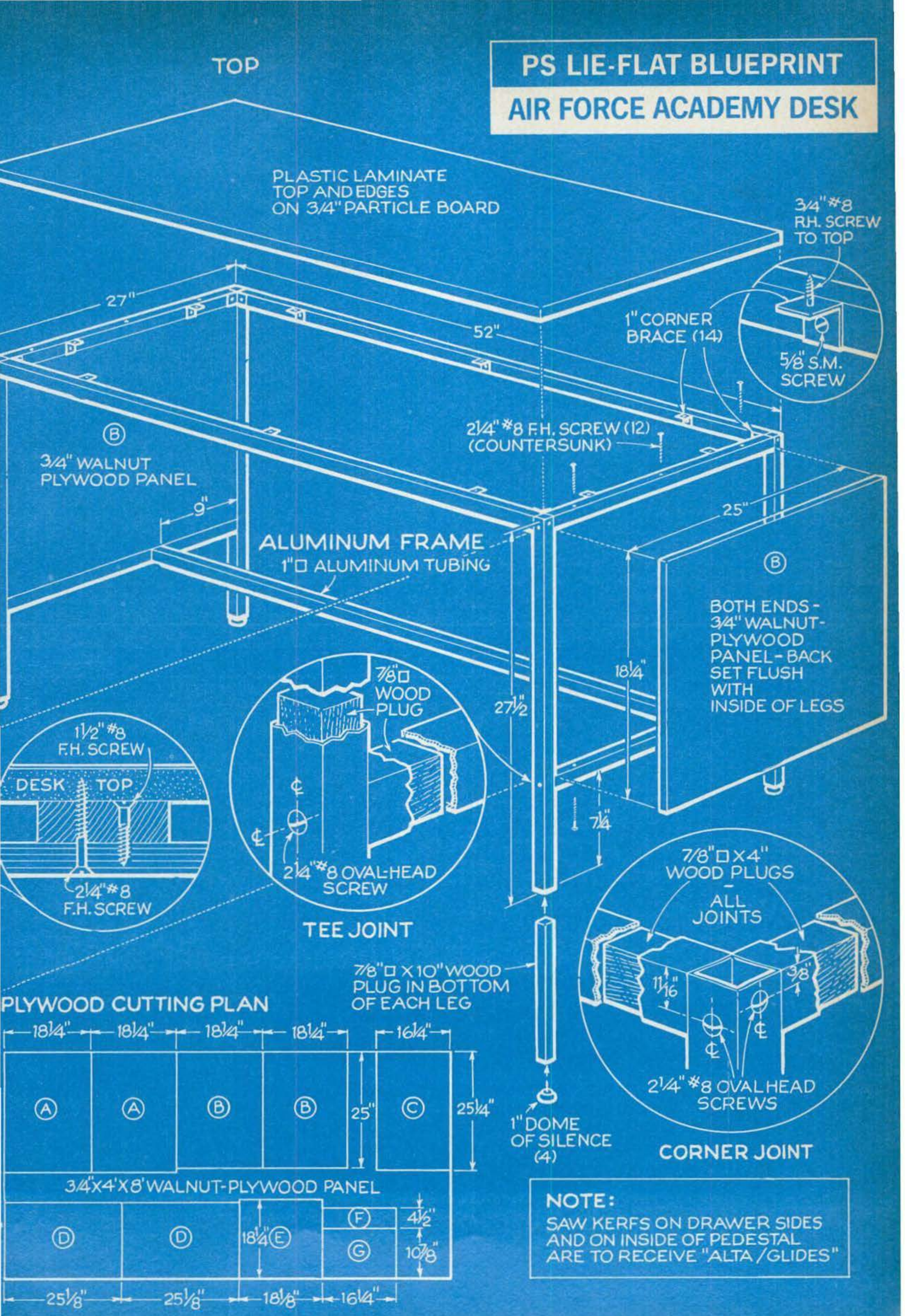
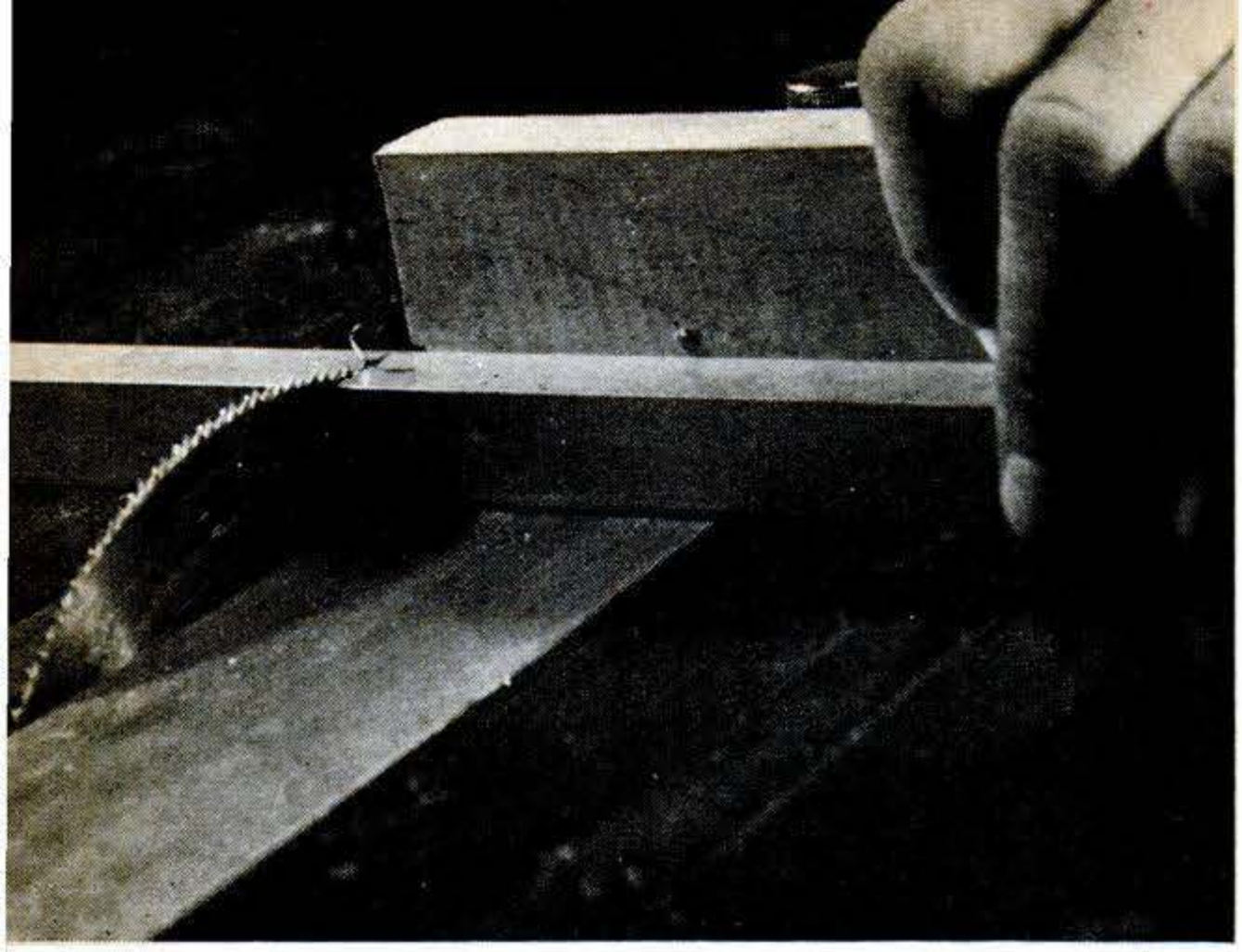

PULL-OUT SLIDE AND DRAWERS
1/4"X 3/8" GROOVE O.C.
25½"
16¼"
BULLET CATCHES
3/4"□ WALNUT
3/4" WALNUT PLYWOOD
1/2"X1/2" ALUMINUM ANGLE TO FIT
SAW KERF 1/4" DEEP – BOTH SIDES (TO SUIT CASE)
1/2"X1/4" DADO
3-1/4"X1/4" DADOS
23¾"
4¾"
4⅞"
1/4" HARDBOARD DIVIDER (3)
21¼"
35/8"
SCREW TO FRONT AS BELOW
1/4"X15¾"X21¼" HARDBOARD (2)
5/8"
1/4"X1/4" GROOVE – ALL SIDES
DRAWER BOTTOMS
24¾"
1/2"X1/4" DADO
14"
1/4"X1/4" DADOS
1/2"X1/2" ALUMINUM ANGLE ON TOP AND SIDES – MITER CORNERS
CUTOUT FOR DRAWER PULL
1/4" HARDBOARD DIVIDER (2)
TO SUIT CASE
ALL SIDES 1/2" WOOD
SCREW TO FRONT WITH 2 1"*8 F.H. SCREWS
SAW KERF 1/4" DEEP – BOTH SIDES
DOVETAIL
5/4"X3" FILLER CLEATS
16"
ALL SIDES 3/4" WALNUT PLYWOOD
SAW-KERF GROOVES FOR PLASTIC GUIDES 1/4" DEEP BOTH SIDES
10"
25⅞"
3⅞"
3/4"□ WALNUT
1/4"
3/8"
MITER ALL CORNERS
3/8"x3/8"
1/4"x3/8" GROOVES
2 STRIPS 3/4"□ X 12" TO STRADDLE STRETCHER USE 1¼" #8 SCREWS
3/8"□ STRENGTHENER IN MITERED JOINT
DRAWER CASE

# PS LIE-FLAT BLUEPRINT

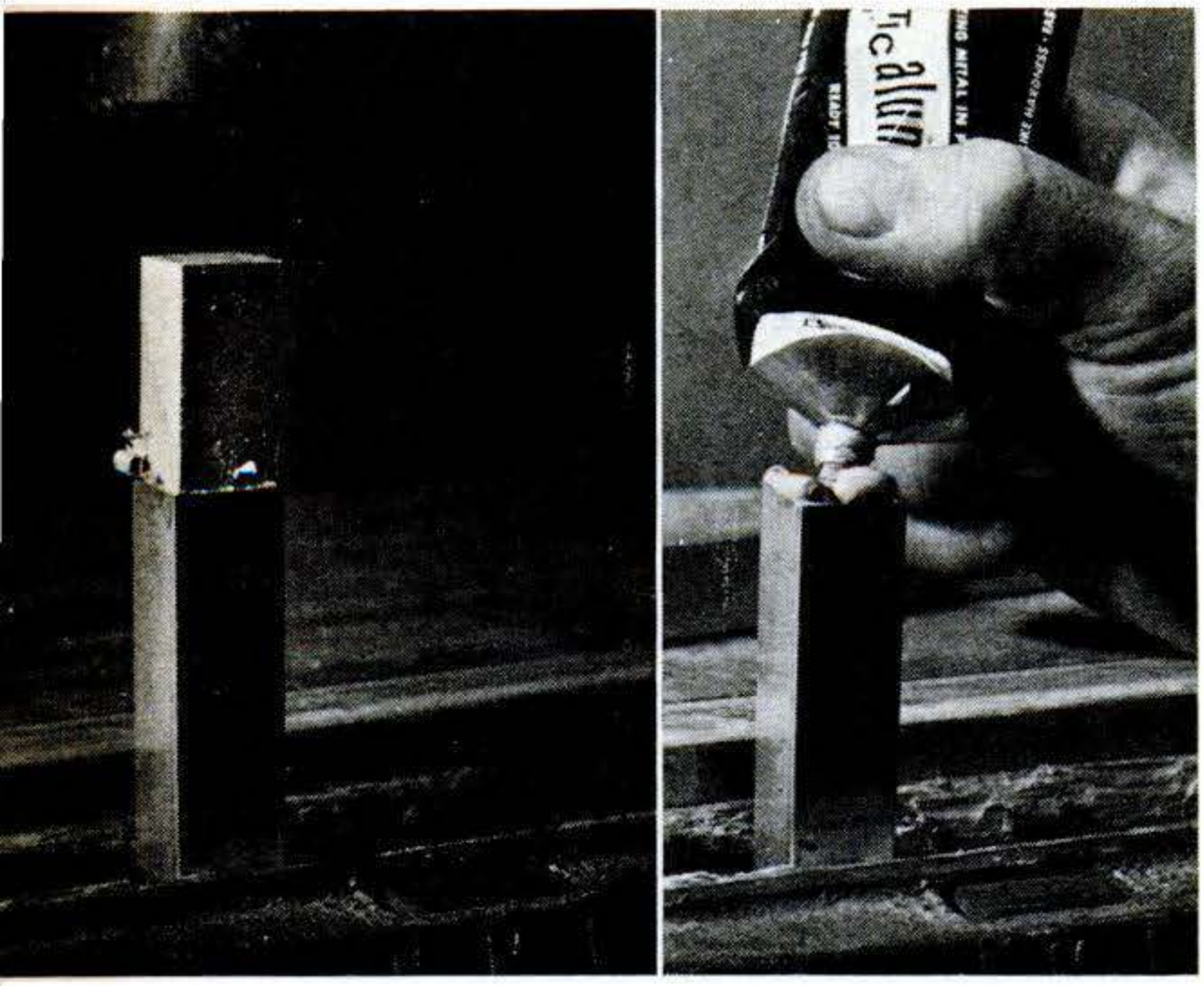
## AIR FORCE ACADEMY DESK




**NOTE:**
SAW KERFS ON DRAWER SIDES AND ON INSIDE OF PEDESTAL ARE TO RECEIVE "ALTA/GLIDES"



**Fine-tooth cutoff blade** slices aluminum fast, cuts even better when it's sprayed with silicone. Put on safety goggles—a must—for this operation.



**To secure screw plugs,** cut them slightly oversize, so they are "shaved" by tubing when driven. Next, apply aluminum cement or epoxy as at right.

## Five easy steps toward a weldless aluminum frame

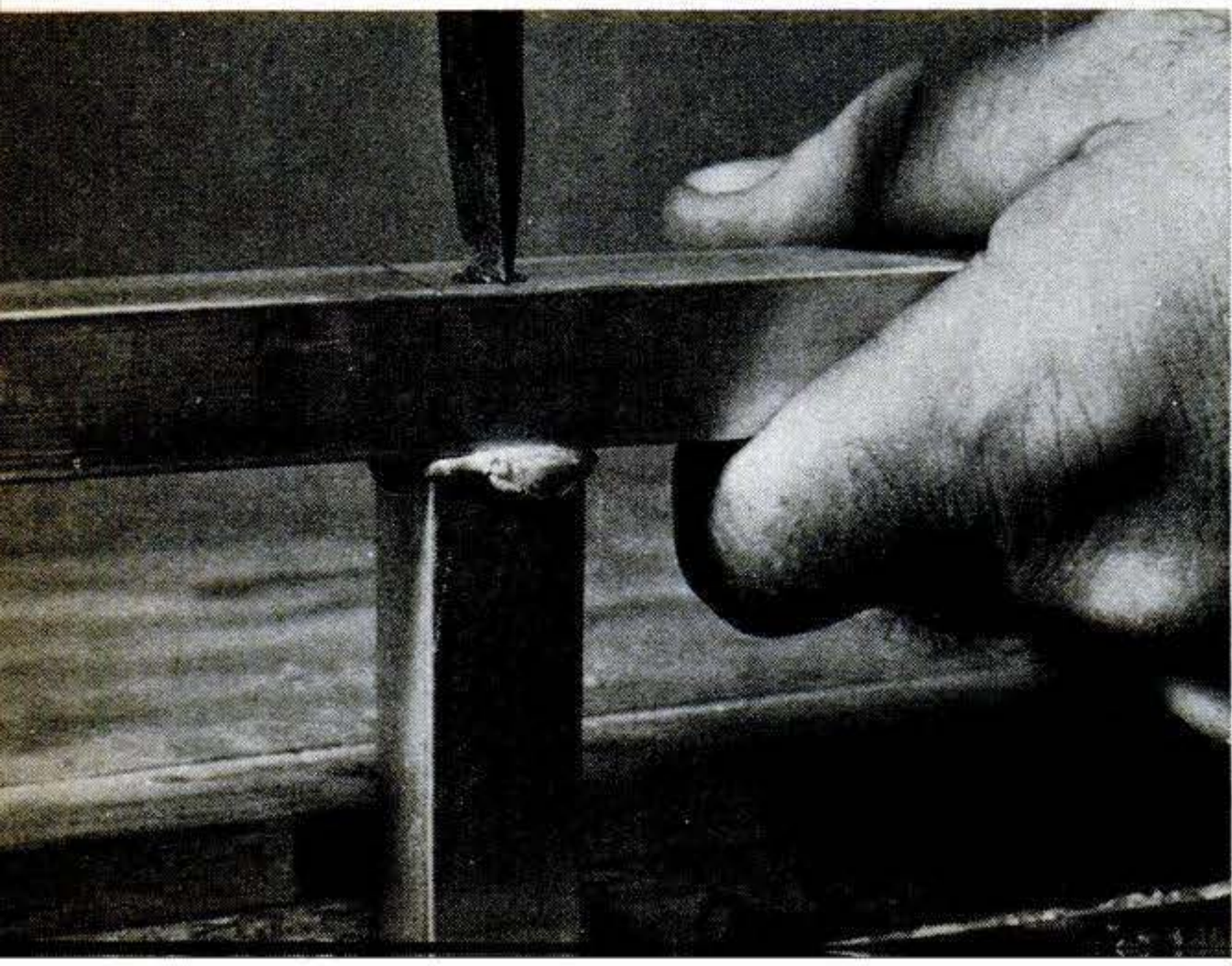
With one bottom cleat attached, place the case on the lateral stretcher. After aligning the unit, clamp it to the leg to prevent movement while you fasten the second cleat. Finally, run the screws up into the top.

Two bullet catches installed in the back edge of the slide-out shelf aid in pulling it out. A slight push on the front springs it forward enough to be gripped with your fingertips.

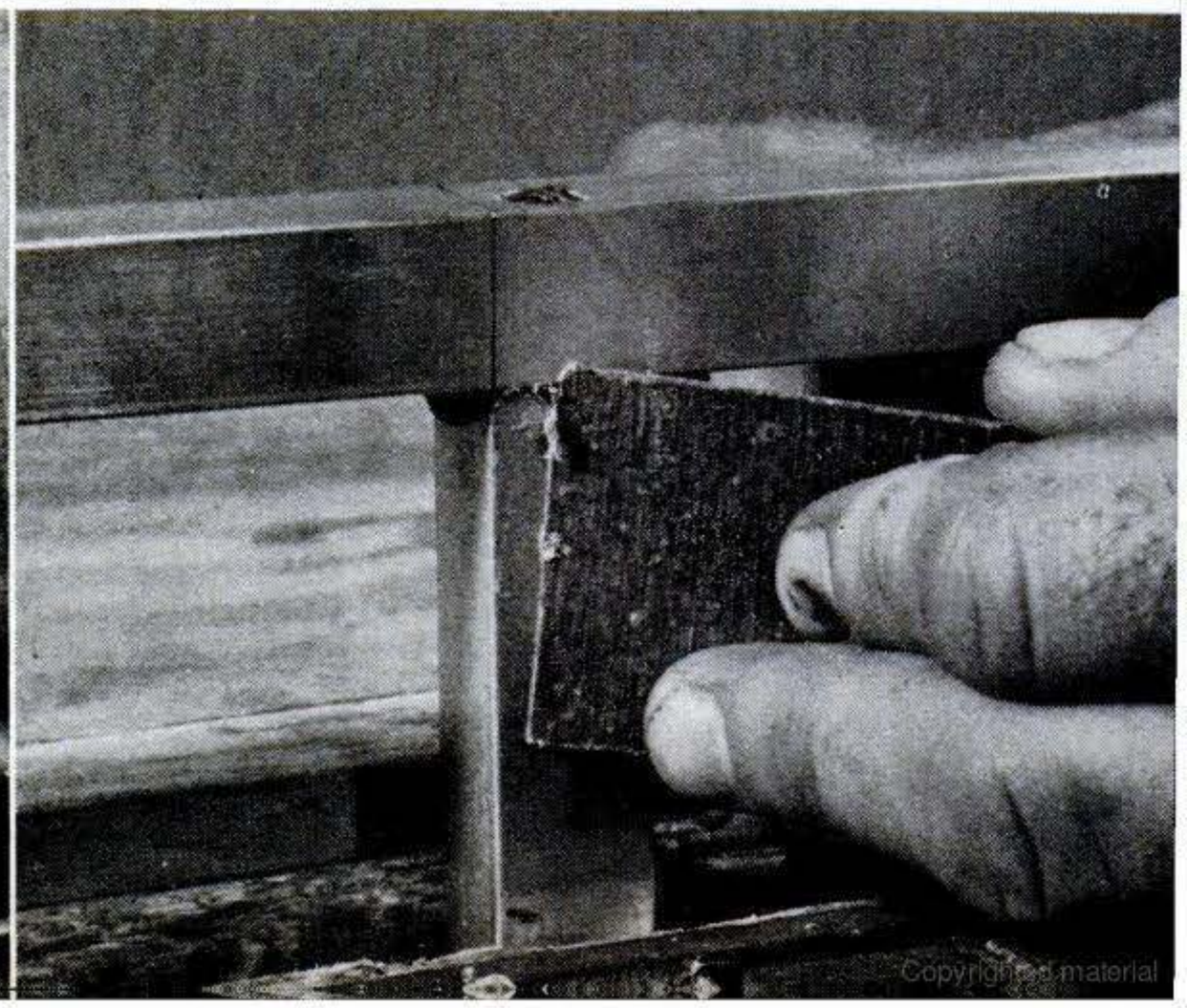
The drawers are of ½" stock and dadoed to take hardboard dividers. Shape the drawer-front edges and attach the angle before fastening the fronts to the drawers.

The drawers slide on glides made of Delrin installed in the drawer case in saw-kerf grooves mated to those in the drawers. You'll need three pairs (available from Alta Industries, 3015 N.W. Industrial, Portland 97210, for $3).

**Finishing the piece.** Use walnut oil stain followed by a sealer such as thinned shellac, and a coat of lacquer. We followed Academy specs and gave all exposed wood a second coat of lacquer. Let the finish cure for two weeks, then use double-0 steel wool, and follow with two coats of paste wax. Buff the surface to a sheen with a stiff, clean brush. To give the aluminum a "grain," rub it with fine steel wool or use a fine-wire wheel chucked in your drill. A coat of lacquer will keep the metal bright. PS



**After drilling and countersinking** aluminum tubing, frame is joined with oval-head screws. Excess aluminum paste squeezes out, fills any voids in joint.



**Aluminum cement is cleaned off** as soon as screw is turned home. After scraping off bulk, clean away any traces with rag and solvent before paste dries.

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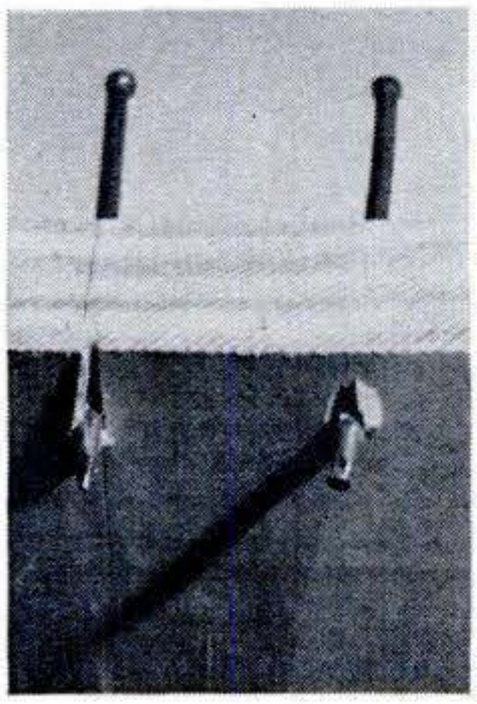
# Shop Talk

By ROBERT P. STEVENSON

## Here's why it sometimes pays to blunt the end of a nail



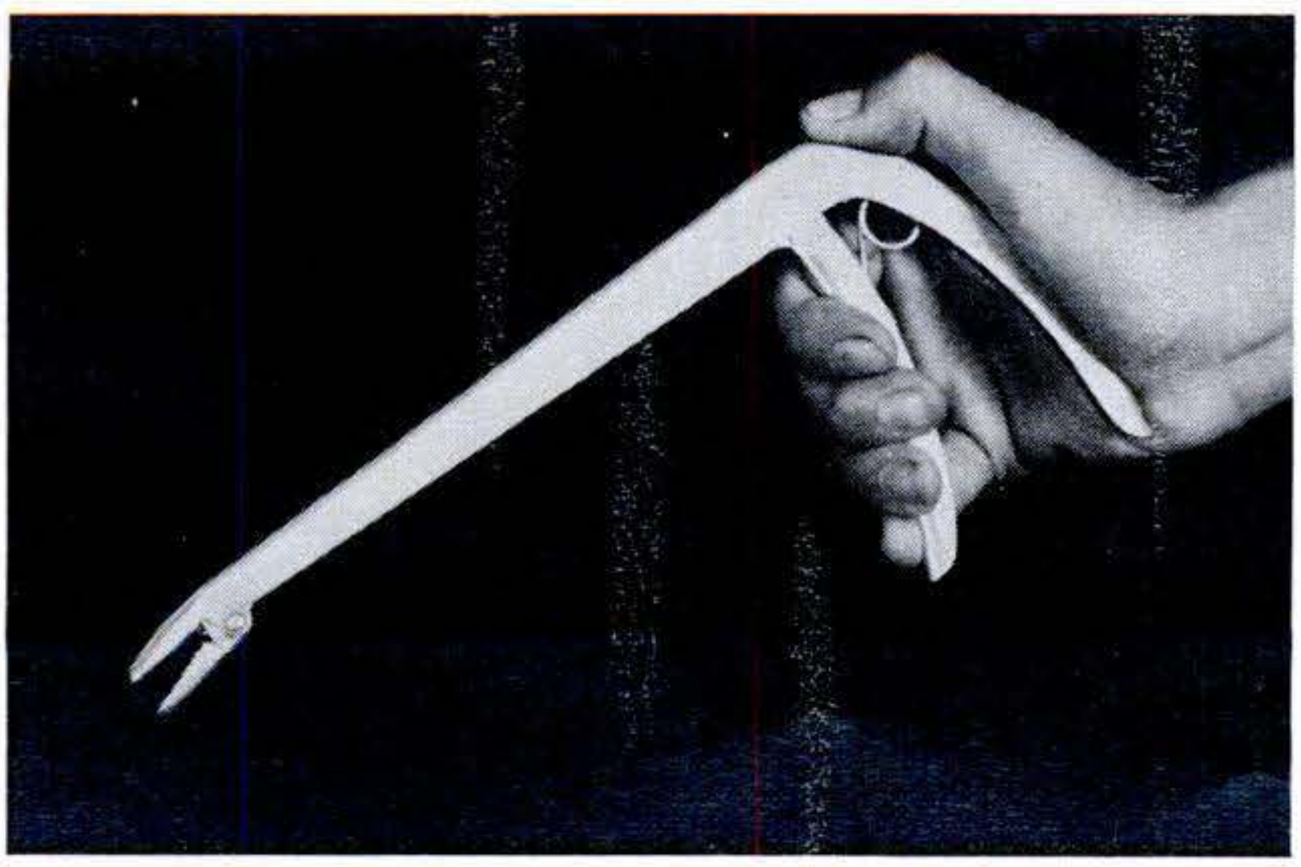
Generations of carpenters have known that a blunted nail is less likely to cause a split than one with a point, especially when driven near the end of a piece of wood. Do-it-yourselfers keep discovering the fact—and writing to us about it. So I may not be telling you anything new. But when the photo at left came along from a reader it seemed worth publishing as a striking example of what happens. A sharp point pushes fibers apart and causes a split. A blunt end cuts through the fibers rather than pushing them aside. Blunt the nail by resting the head on a solid surface and tapping the point with a hammer.

## New literature that you may want to write for

Some remarkable developments in furniture have occurred in America since the Pilgrims landed in 1620. You can follow these changing styles, in pictures, in a booklet available from Dept. AF, Johnson Wax, Racine, Wis. . . Before you buy new resilient flooring, better check out a new 24-page booklet from Information Service, Armstrong Cork Co., Lancaster, Pa. 17604 . . . Have a problem in weatherstripping a door or window? You may find the answer in "The Weatherstrip Handbook" from Pemke Mfg. Co., 5755 Landregan St., Emeryville, Calif. 94608 . . . Send a postal to Masonite Corp., Box B, Chicago 60690, for "Hints to the Handyman," a listing of 55 useful project plans . . . You might be surprised what you can do with polyvinyl chloride (PVC) foam. A brochure from Plyfoam, Vanderbilt Park, Hauppauge, N. Y. 11787, tells how to build an eight-foot boat weighing only 27 pounds.

## Brief reports about various new tools you may want to try

The 9½"-long tool with the right angle shown in the accompanying photo is designed for handling small parts in tight places. Baker Mfg. Co., Columbia, Pa., offers the Hookout for $2.25 . . . Vaco offers seven sizes of hex-key wrenches a full foot long. Vaco Products, 510 N. Dearborn, Chicago 60610 . . . Several of Montgomery Ward's electric drills have an excellent feature that's not now listed in the catalogue: a handle cartridge that holds 10 bits . . . Evans Rule Co., Elizabeth, N.J. 07206, is introducing a line of tapes in cases almost as thin as a watch. The steel blades are only ¼" wide, in 6', 8', and 10' lengths . . . S-K Wayne Tool Co., 332 S. Mich. Ave., Chicago 60604, has assembled a 26-piece general-purpose socket and tool set (No. 4126) that looks like a fine deal at $49.98 for farmers, mechanics, and serious do-it-yourselfers . . . H. K. Porter's Disston carbide-tipped circular saw blades are now being given a Teflon coating.





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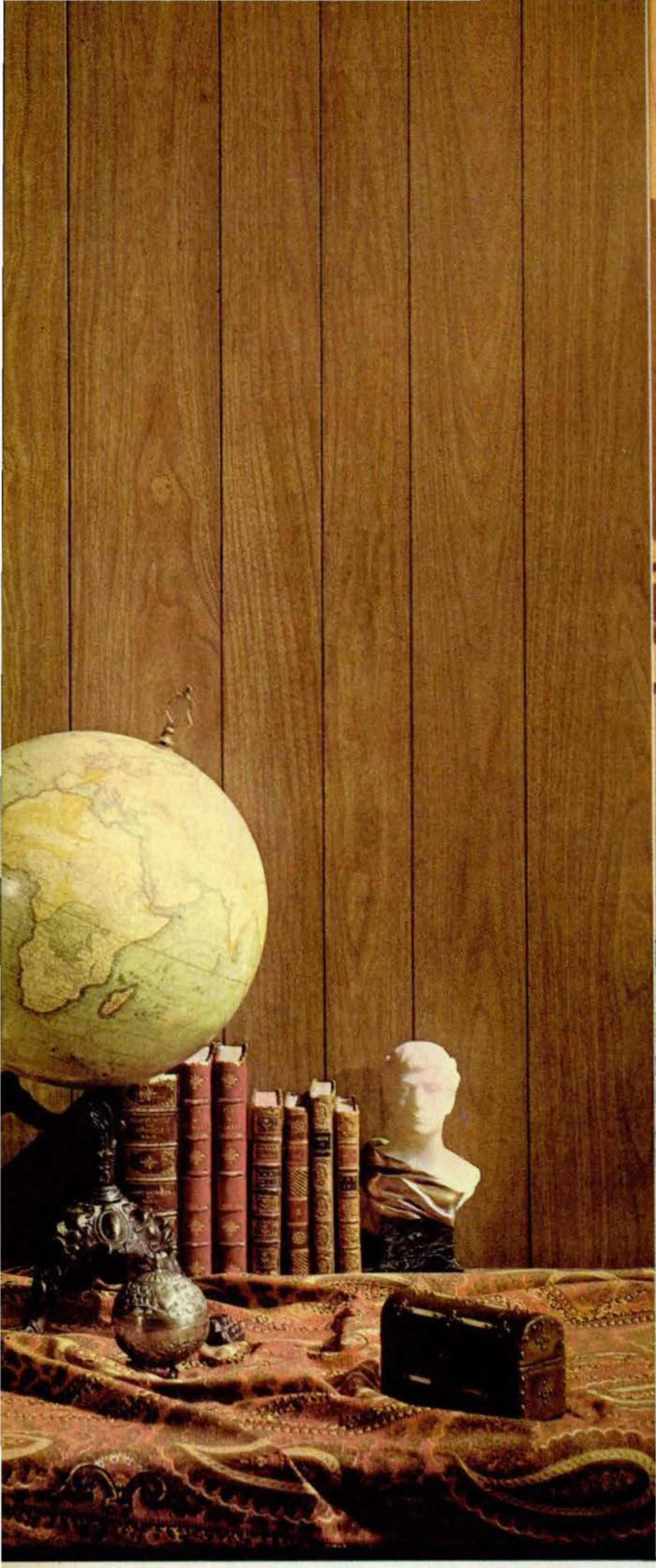

**Wood grains from around the globe** are yours economically on hardboard panels—precise photographic reproductions of real wood, sealed beneath a baked-on finish superior to anything you could apply.

**A new fruitwood grain,** Cinnamon Cherry, adds a spicy note to Masonite's Royalcote line. It's equally at home with period or modern decor. A new process is used to create deliberate grain mismatching.



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# The Wild New Effects in Hardboard Paneling

**The variety of patterns and textures permits wall treatments that used to be impossible**

By JACKSON HAND

How would you like a bedroom wall covered with a deep-textured tapestry so rich that, obviously, almost nobody could afford it? Or a family-room wall sheathed in so much saddle leather it would make a Texas rancher jealous? Or a dining room paneled with more wormy chestnut than you thought was left in the world? Or travertine marble on every wall in the bath—as if travertine grew on trees?

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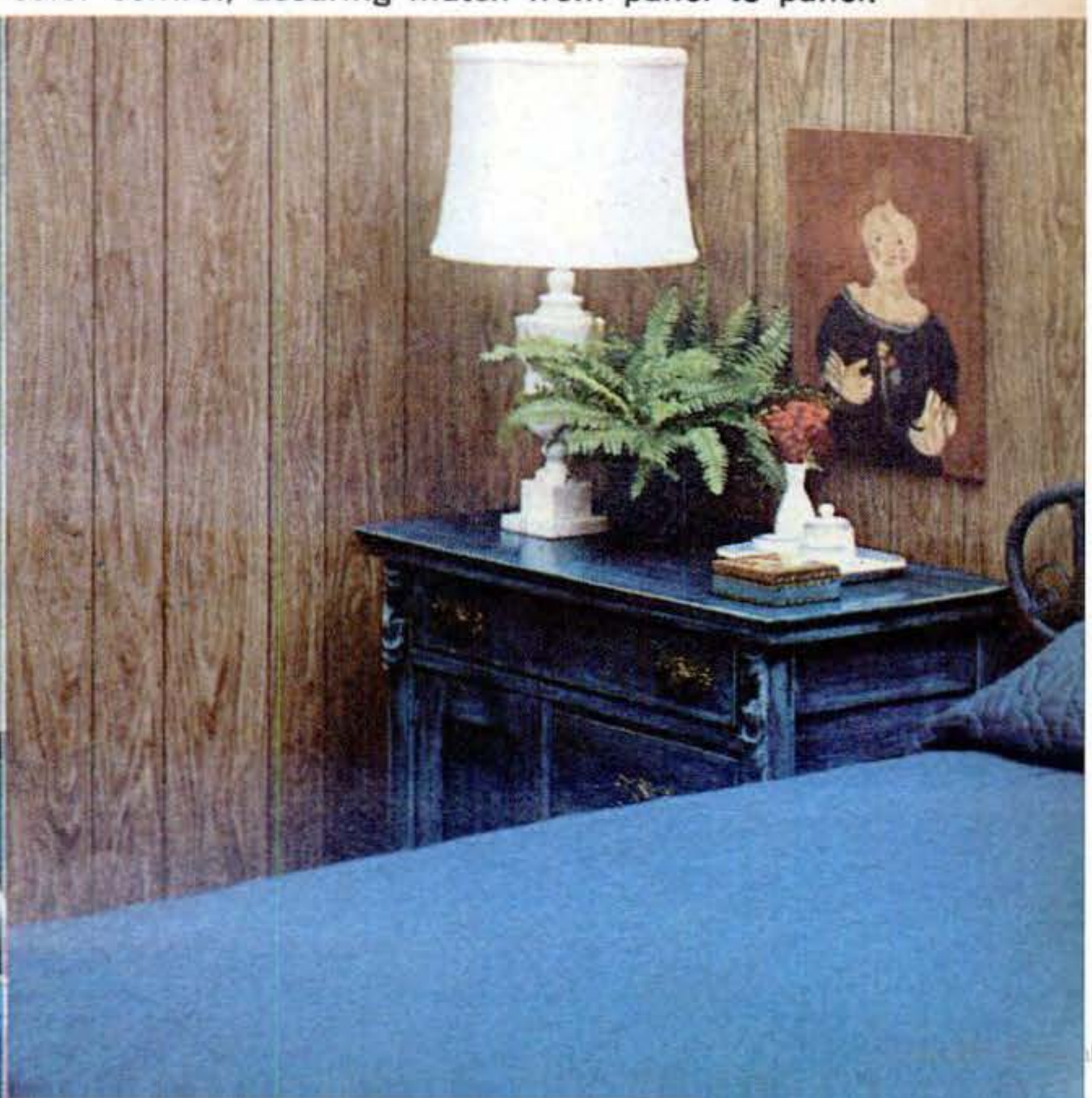
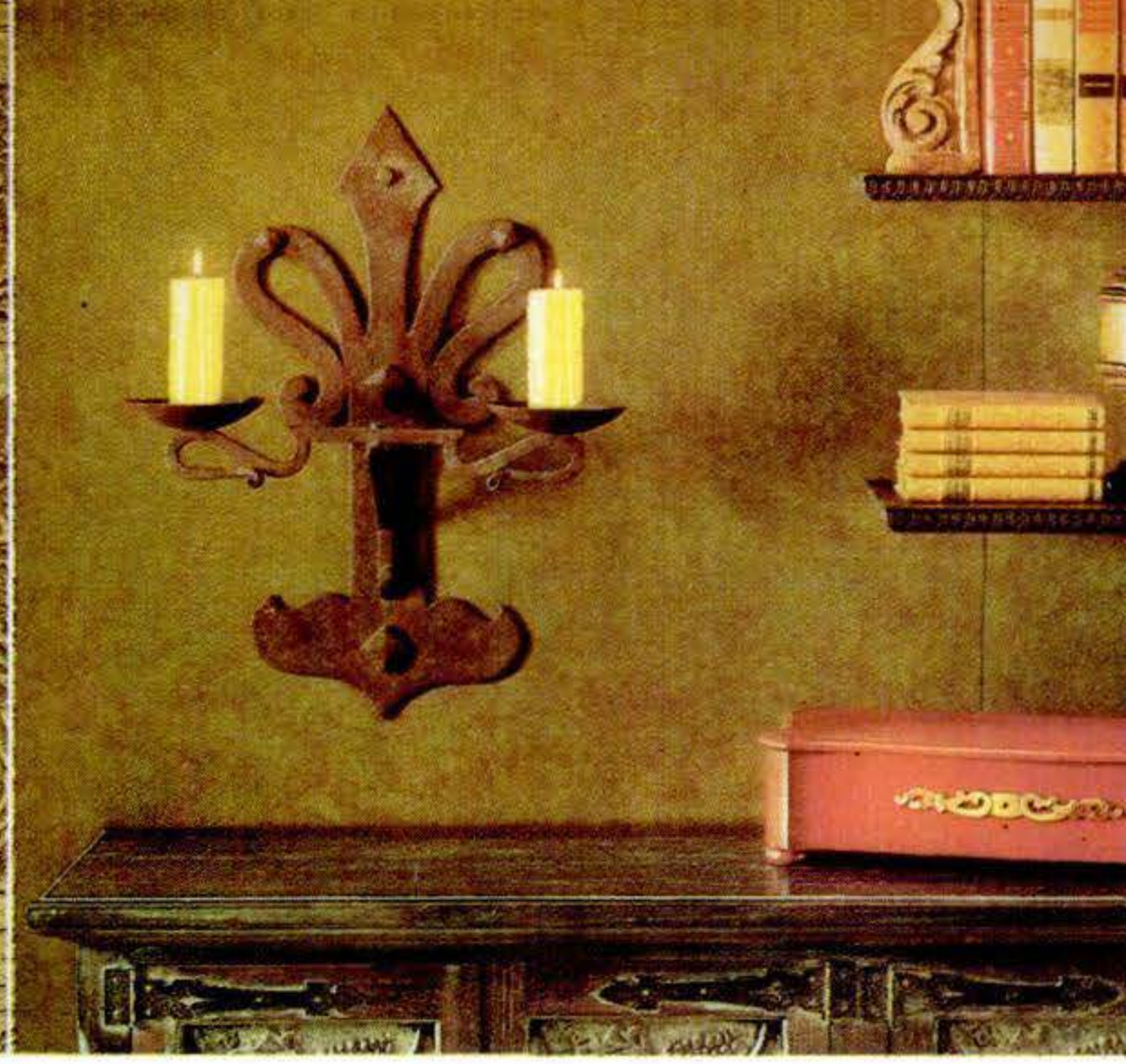
**Since hardboard can be textured,** it can simulate any surface. This rustic-plank installation — a major chore with actual material even if you could buy it—is simple with these Armstrong's Sturbridge panels.

**Even more rustic effect** can be achieved with this Abitibi paneling called Barn Board. With hardboard paneling's photographic process, there's complete color control, assuring match from panel to panel.



**Of all paneling materials,** hardboard comes in the most patterns, reproducing virtually all types of wall coverings. Marlite's Textured Tapestry looks and feels like woven fabric, yet can be damp-wiped clean.



**A leather pattern** comes from Marlite in four different but standard leather colors, including green, white. It not only looks serviceable; it is an excellent choice for a breakfast nook, bar, game room, family room.

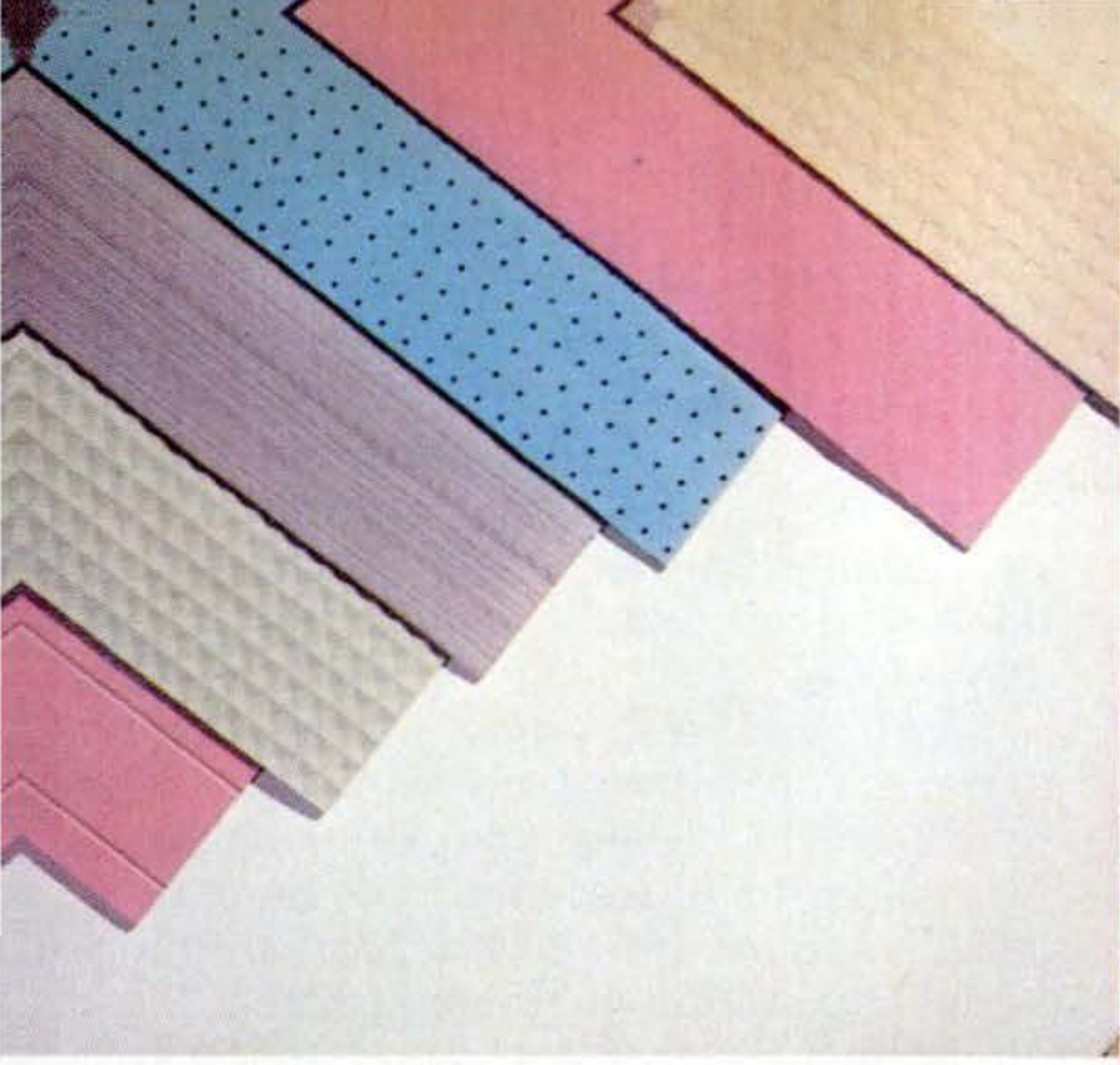
Well—it does grow on trees, and so do all the above-mentioned luxuries, plus many more, when you buy them as hardboard paneling.

Hardboard has two special characteristics that make it ideal as paneling. First, since it is made of wood that is ground up, and then re-formed into sheets, it can be given any desired texture. Makers do this by grinding or abrading the surface of the finished sheet or by putting the texture on a steel roller and impressing it into the board as it is being formed. You can have any wood texture, including old barn siding; any fabric texture, including burlap; a variety of non-wood surfaces, including tile; and an endless range of novelty textures such as basket weave and louver.

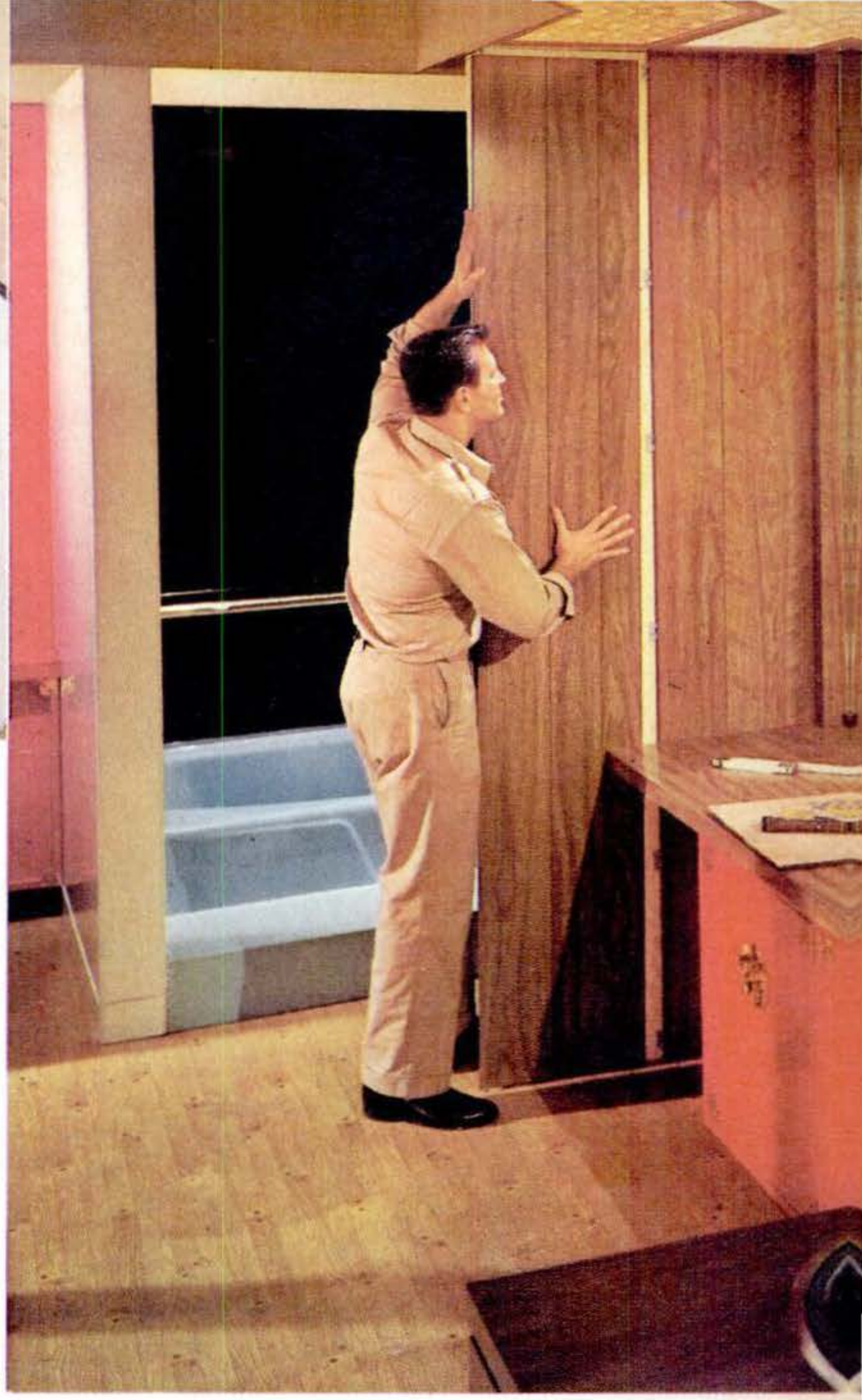
The second characteristic of hardboard that contributes to its wonder as a paneling material is the way it takes finishes. Colors, duotones, wood effects, gold metallics, etc., are teamed up with various textures. In addition, there are many plain colors in glossy and satin finishes—including a perfect chalkboard you can put up for household messages.

**A choice of finish.** Most hardboard paneling has a finish similar in protective quality to that you get with prefinished plywood paneling. It is entirely washable, and will withstand the action of soaps and

**The variety of textures,** patterns, and utility built into hardboard paneling makes setting like this easy to create. Masonite's Living Wall panels, used here in a light, wood-grain pattern in the shop area, come with slots cut in the "joints" to accept shelf brackets and other hanging fixtures. New rough-textured Royalcote in Charcoal Brown (left and on desk wall) complements rough beams for an informal effect.



**Textured hardboard patterns** come prefinished, or simply primed, in some lines, so they can be used either as they are—or with your choice of color. These patterns are samples from U.S. Plywood line.



**Paneling in 16-inch widths** is offered by some manufacturers, to match stud spacing. Easy for one man to handle, these panels (by Marlite, above) go up with clips and adhesive, eliminating surface nails.

detergents. It is, in fact, a great deal closer to being waterproof than the manufacturers' labeling would indicate.

Most of the clear surface coatings are thermosetting plastic resin—that is, they are baked on, with a smoothness and durability you could never achieve in a hand-applied finish. At least one brand—Marlite—boasts a finish applied by a curtain-coating process; the panel passes through a waterfall of melamine plastic for a layer of greater thickness than is possible with the more common roller-coating method.

Your choice of finishes may be important in certain applications. For classic wet situations — baths and kitchen-sink

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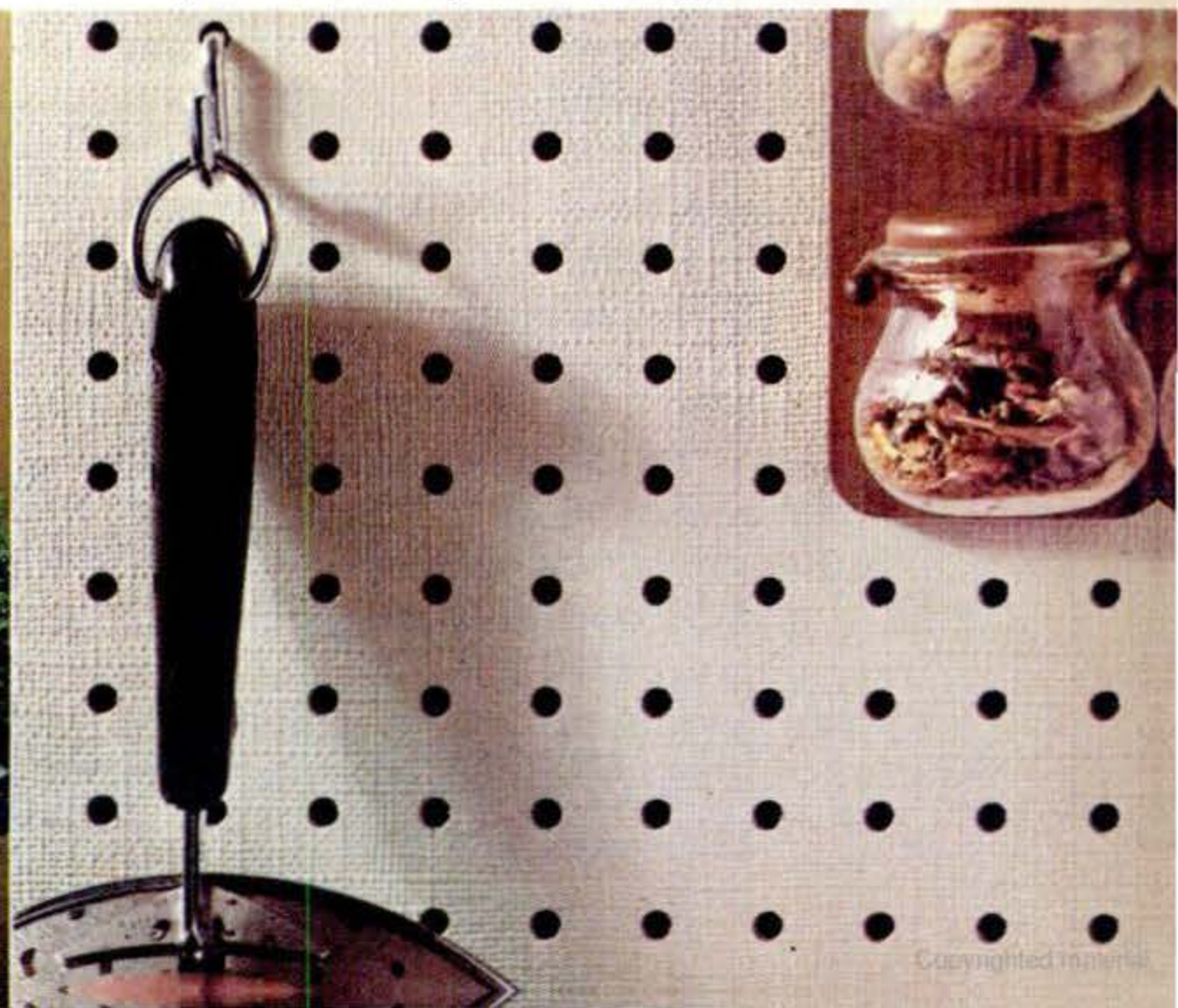
**Accent areas for painted walls** are an effective use of hardboard paneling. Below, one of Weyerhaeuser's Muralwood series of grain patterns handsomely sets off back wall of a living-room entertainment niche.



**New faces for perforated board** are bringing this utility panel out of the workshop. U.S. Plywood's fabric pattern is one of many textures and colors that can provide working walls throughout a house.

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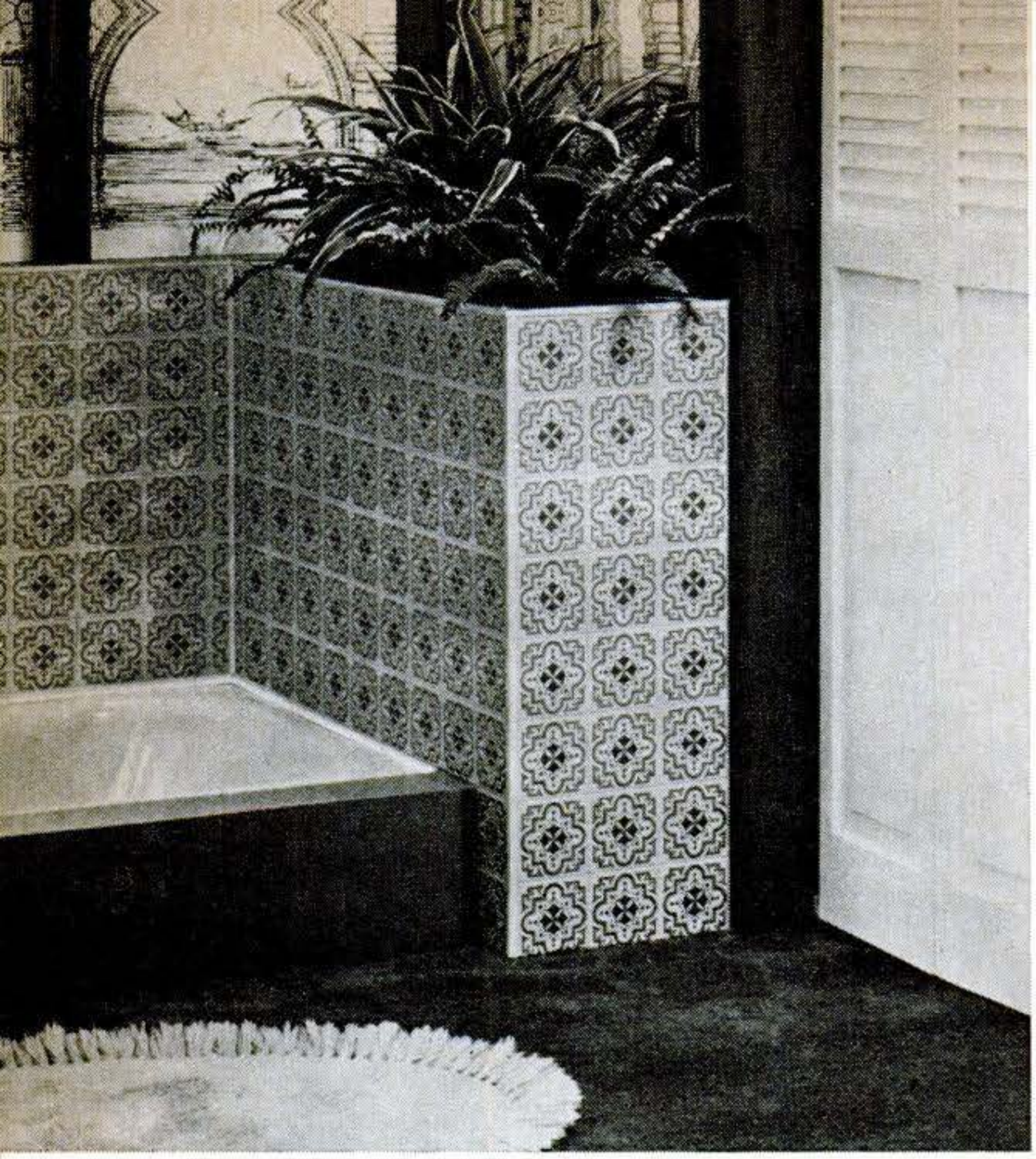

**Waterproof hardboard paneling** offers many economical possibilities for tub-niche treatments. Tile pattern used here for splash panels and planter is from Marlite, as is mural above it—one of a series.

areas, shower linings, and the like—look for specifications that plainly state the materials are intended for such use. Otherwise, you may find that moisture will soften the hardboard backing. Not only do the panels intended for wet-area use have a more waterproof finish, but the finishing material is usually carried around the edges, so that deterioration due to water will not set in at the seams, and move to the back of the sheets. Look for it when you buy.

This special attention to water resistance is usually given to finishes on the harder, tougher tempered hardboard.

**The thicknesses.** Hardboards used for paneling are of three basic types—resulting in three basic thicknesses. Board produced specifically for paneling in standard living rooms doesn't need to be particularly strong. It is, therefore, often of a softer hardboard up to 9/32 inches or a little thicker.

The two other types and thicknesses are merely finish-coated versions of the old familiar construction board—1/4-inch standard and 1/8-inch tempered. Don't, therefore, judge panel quality on the basis of thickness. The thickest panels may be the least expensive; while those panels recommended for use in wet areas are likely to be the dense, rugged 1/8-inch stuff.

These thinner materials can often go over existing walls without any need for removing or altering existing trim, particularly with the mastic installation widely recommended for hardboard. Also, the thinner sheets can be laminated to doors without remounting the hinges and door stops.

**Sheet sizes.** Like most other paneling materials, hardboard comes in standard four-by-eight sheets, and is available in lengths up to 10 feet and more on special order. A most useful variation of this is a line of paneling in 16-inch widths. This dimension matches the standard 16-inch spacing of most residential stud framing, allowing the use of clips that hook the edges of the paneling. Nails are invisible, except at top and bottom, where they are covered with molding. Installation of this paneling may involve the use of adhesives, too.

Some dealers handle a third form of hardboard paneling: ceiling blocks about 16 inches square, with interlocking grooved edges for nailing.

**Installation tips.** All makers of hardboard paneling offer a line of installation hardware and moldings to cover every situation. In some cases, the moldings are metal or plastic, and are kept small and unobtrusive. Others supply moldings of wood, colored to match the panels. Another way manufacturers sometimes handle the molding problem is with stains mixed specifically to go with their panels; you stain less-expensive moldings of your choice, from your own lumberyard.

Since the most common installation techniques involve adhesives, the makers of hardboard for paneling usually offer mastics, both in bulk and in gun cartridges. The bulk material is intended for overall application by means of a comb-tooth spreader, a common specification being 3/16-inch teeth 3/16 inch apart.

Most makers of hardboard paneling emphasize the need for space between panels to allow for expansion. In some cases, a V edge helps make the joint invisible, even though it is not a tight butt. It is often recommended that you avoid nailing both ends of a panel, to avoid buckling or cracking as panels swell or shrink with humidity changes. PS



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# The Safe Paints to Use Around Children

By JACKSON HAND

Many labels these days carry a statement that until recently was never seen on a can of paint: "Specifically recommended for surfaces accessible to children." Even when the statement is less direct, stating merely that the paint is nontoxic, you know it is free from certain poisonous or harmful materials.

It may be confusing, however, to find the same paint cans carrying the warning: "Keep out of the reach of children." The reference in this case is to the paint in its liquid state. Toxicity of liquid paint is due to ingredients that evaporate and are not present in the dried film.

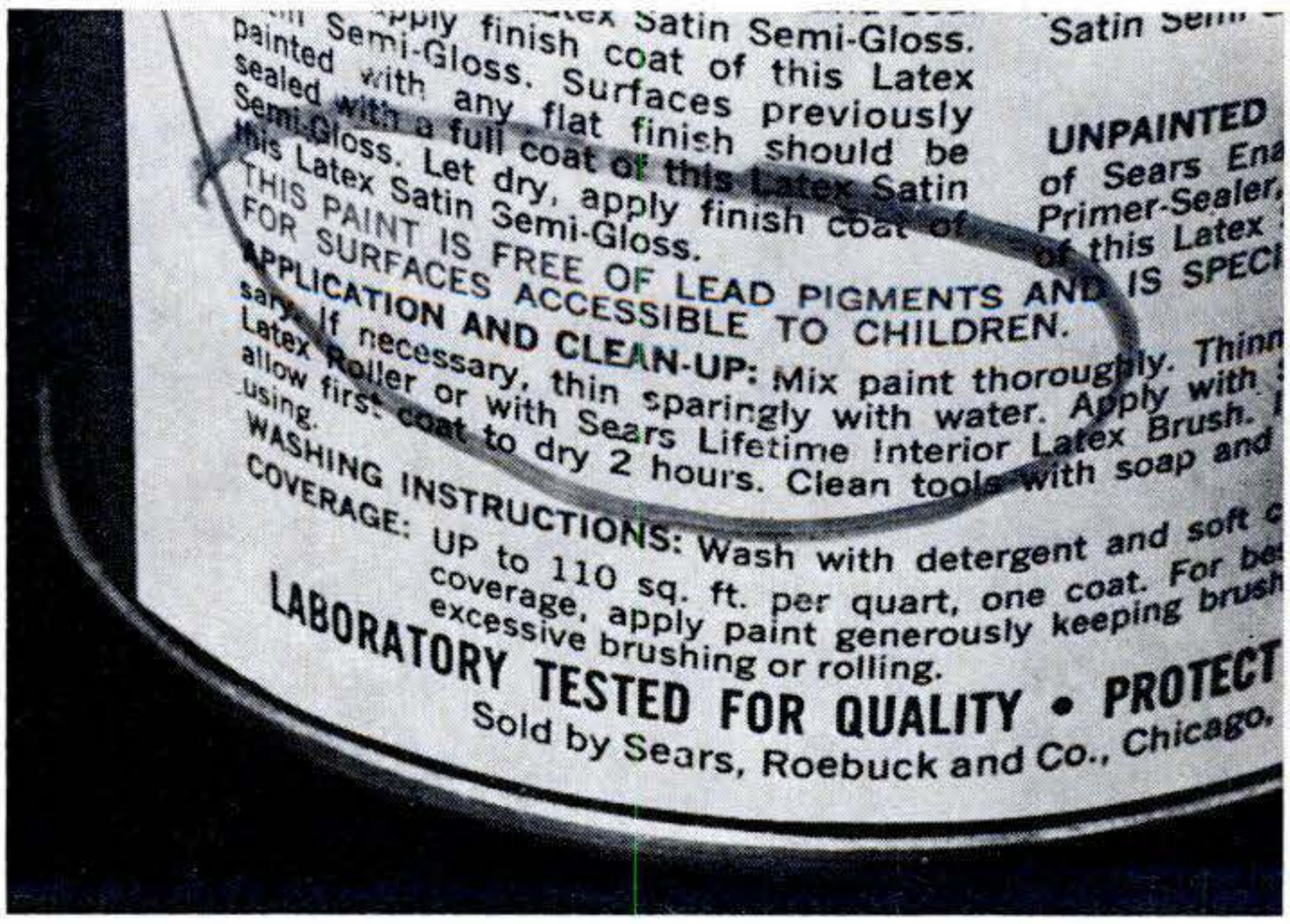
A lot of paints (for instance, just about any paint intended for use outdoors) contain toxic materials in the dried film and should never be used where children (or pets) might swallow flakes of it. This is particularly important on toys, cribs, and playpens.

Most of the time, toxicity in a paint is due to its pigments. Lead is the greatest offender. It is an ingredient in a large number of the most durable pigments. Other ingredients—such as mercury, antimony, cadmium, arsenic, and selenium—are potential poisons.

Since 1964, the American Standards Assn. has prescribed strict specifications for paints intended for use in children's rooms. Basically, they hold lead to one percent of the dry film, other potential poisons to .06 percent of the solids. Water-soluble barium is controlled, too. But . . .

- Not all the paints of a given maker may be safe.

[Continued on page 198]




**Some labels specifically state** that the paint is safe for use around children. If the label says nothing, it's fair to assume that it probably doesn't meet nontoxicity specifications and should be avoided.



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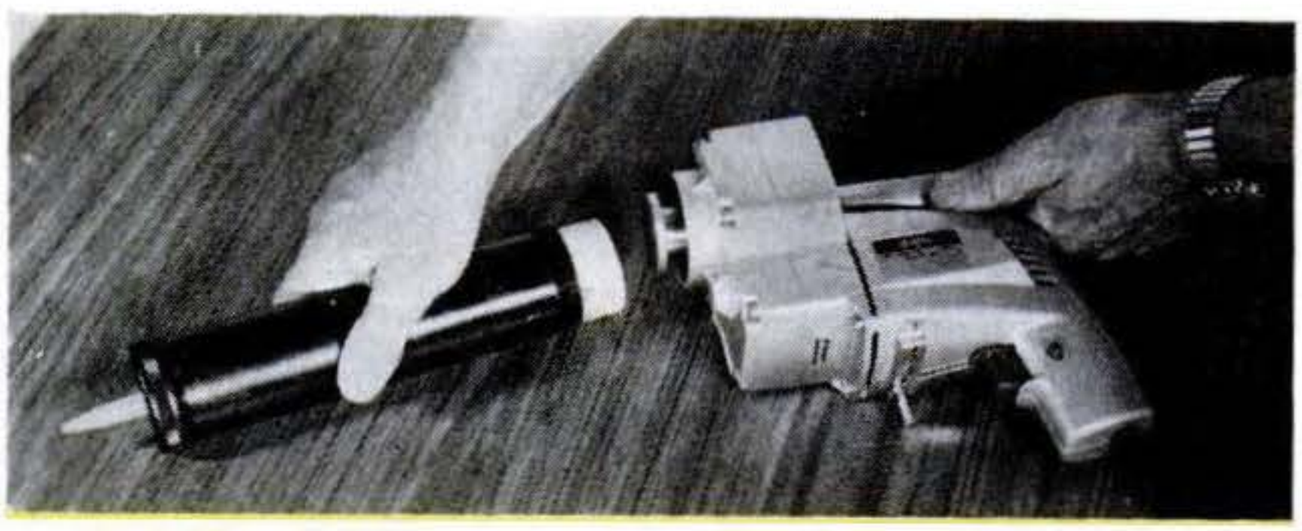
## PERSONAL-USE REPORT:

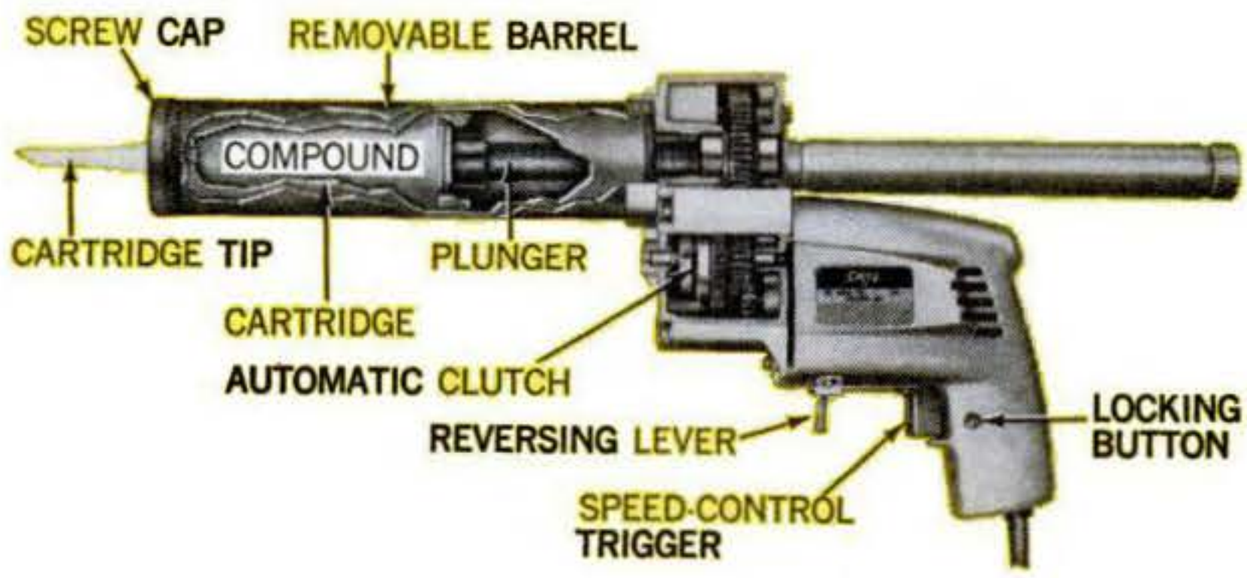
# Skil's New Electric Caulking Gun

By E. F. LINDSLEY
*PS Outdoor Power Equipment Editor*

**Trigger pressure** controls rate at which compound flows into joint. Only a little practice is needed to lay a perfect bead.



**Cartridge** fits into removable barrel on gun. A reversing lever cuts off the flow and retracts the plunger.




Caulking is a vital part of home upkeep, but anyone who has hand-milked a standard gun all day knows it can be tough work. Now you can do it with power—and with ease.

Skil's new Model 705 power gun with a three-amp reversible, variable-speed motor really hastens the job and has the pressure (up to 800 pounds) to force thick sealing and glazing compounds into anything from a wall joint to a boat seam. Loading is a matter of dropping any standard 1/10- or 1/12-gallon cartridge into the barrel and screwing the barrel into place.

The reversible feature allows the plunger to be retracted and aids cut-off at the end of bead. This last takes a bit of practice. If you're not careful, you may lay a worm of gook all over your shoes and everything else. But in short order I learned to flick the reverse lever and gun the motor to ease the pressure and stop the flow.

The TSC (trigger speed control) is impressively good. Gentle triggering moves the ram at a barely perceptible crawl for close work; a wide-open trigger shoots out caulking as fast as anyone could aim it. The gun weighs 7¼ pounds, less cartridge.

At $69.95, you may not want to buy the gun if your caulking needs are only once-a-year home maintenance. In such a case, check local hardware stores or tool-rental outlets to see if the gun is available on a rental basis. Skil expects this to be a prime market for the new gun.



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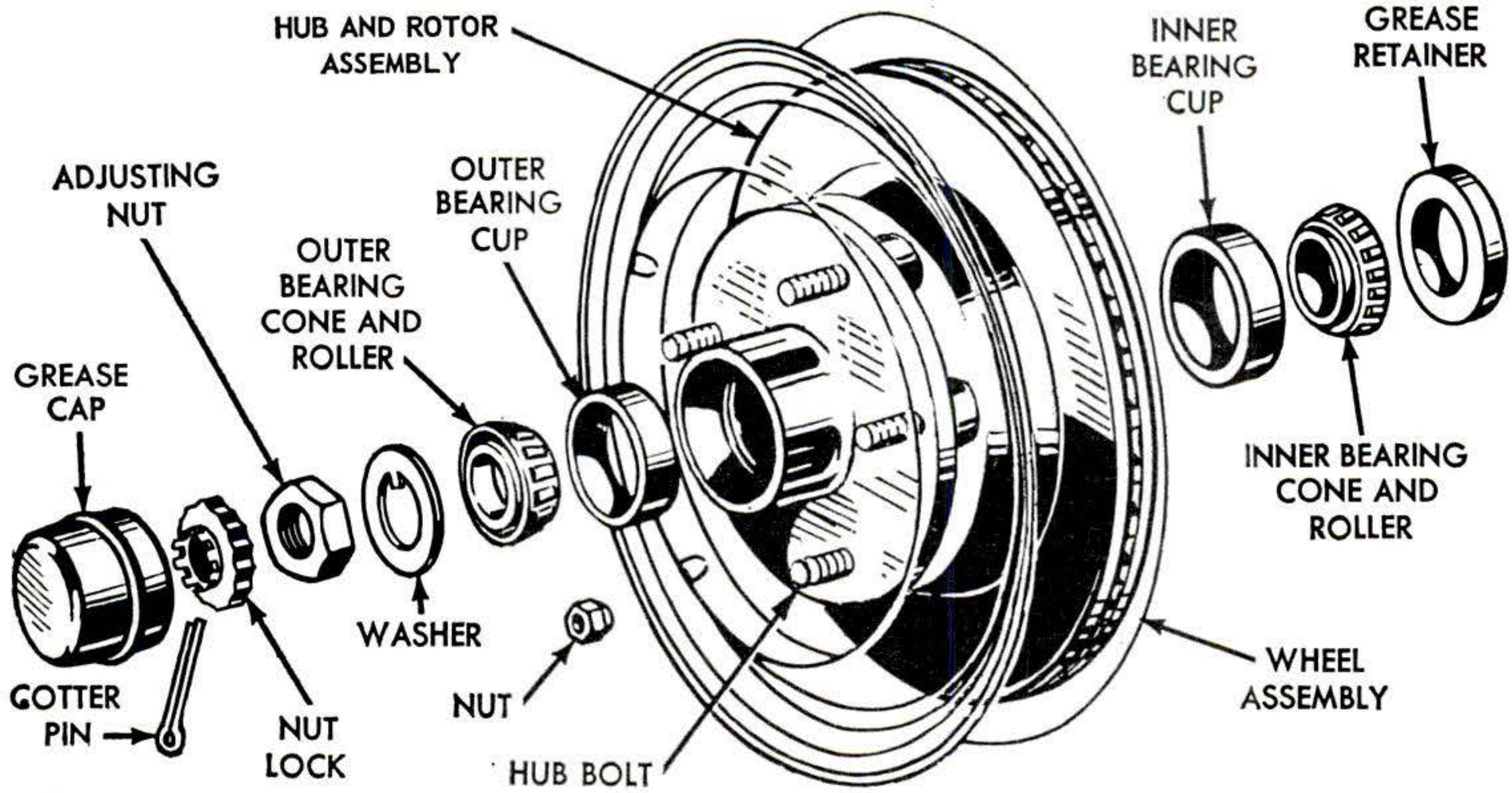
*Here's the latest in Popular Science's series for the car owner who doesn't have a very clear idea about what goes on under the hood—but would like to learn. Knowing your car will save you money and add to your driving pleasure and safety.*

# ABCs of Keeping Your Car in Tune

TENTH OF A SERIES




**Ford's disk-brake hub** uses tapered roller bearings and a special nut lock on the outer end of the spindle. Most other makes of cars use castellated adjusting nuts that are secured by cotter pins.

# How to Keep Trouble Out of Your WHEEL BEARINGS

By HERB CARRIER

Front-wheel bearings are oft-neglected keys to motoring pleasure and safety. Bearing failure at high speed, while comparatively rare, can freeze a wheel and cause disaster. Loose bearing adjustment can wear out your tires through excessive wander. Set your bearings too tight and you'll ruin them.

You can avoid a $20 repair bill by once-a-year cleaning, inspecting, repacking, and adjusting your front-wheel bearings. You'll probably spend about 75 cents each for two new grease seals and about $1 for grease. This grease supply will last for several repacks. For tools you need only a couple of pairs of pliers and a hammer, plus a solvent such as kerosene. For a superaccurate bearing

*Continued*



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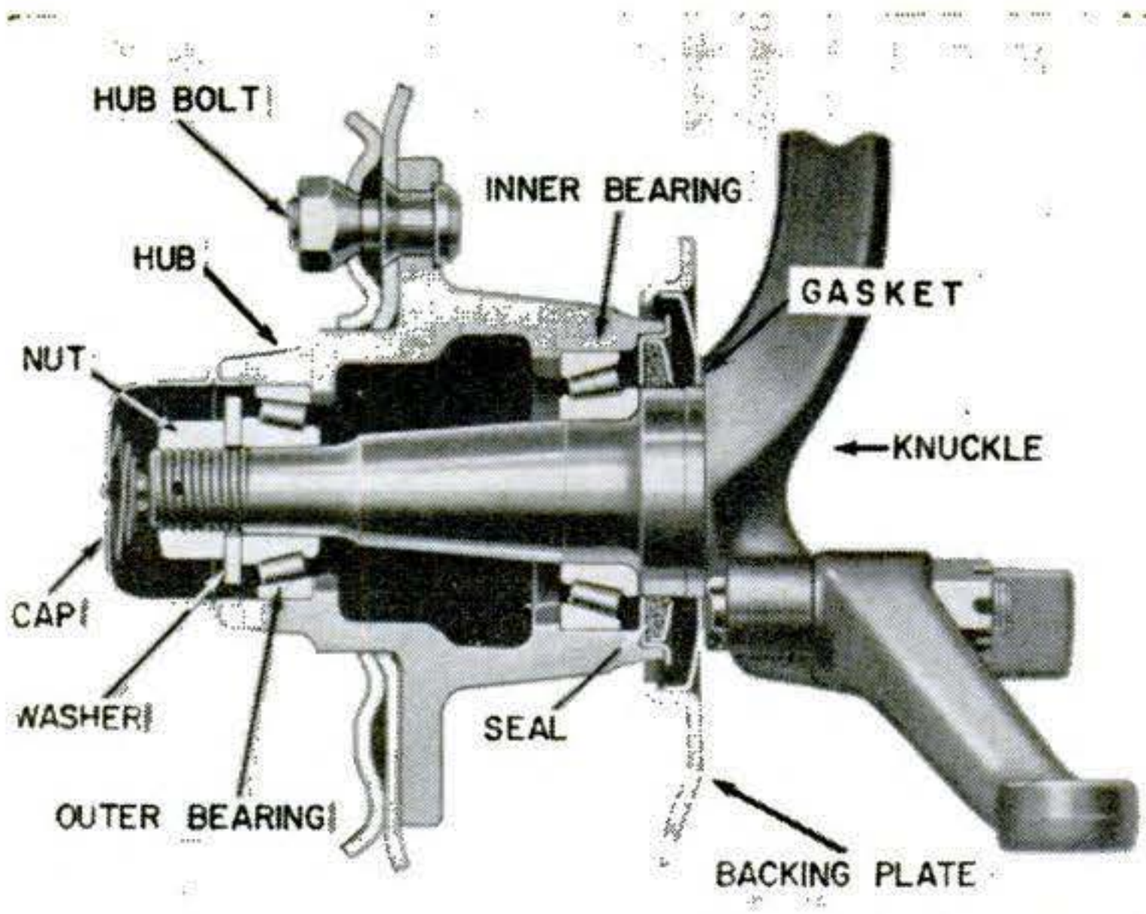



**Front-wheel hub assembly** cutaway shows that the spindle is integral with the steering knuckle. The spring between cap and spindle is a static collector that's designed to improve radio reception.

**Both bearing and bearing cup** should be inspected carefully. Do not remove the cup unless it or the bearing shows signs of damage or wear. Worn or damaged parts that turn up should be replaced.

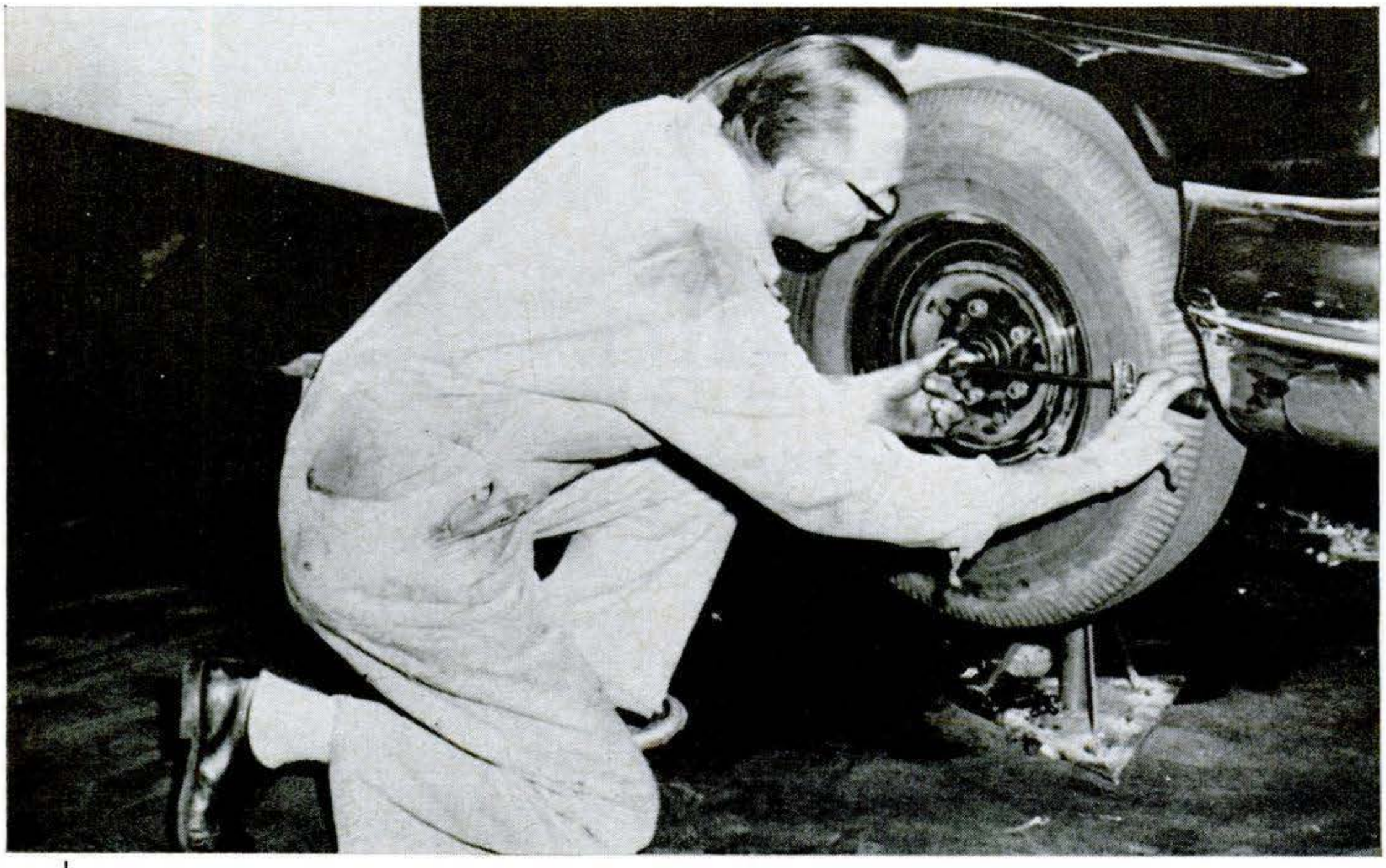
adjustment, you need a torque wrench and a dial indicator. (However, bearing tolerances aren't that critical.) The whole job takes about a half-hour.

But first you should know something about the bearings and the job they do.

**Bearing design.** On most late-model cars your front-wheel bearings are of the tapered-roller type. The rollers are held in a cage. The cage is crimped to a cone. The rollers, cage, and cone make up the bearing assembly. When installed, the assembly fits onto the spindle and into a cup. The cup is a drive-fit into the drum assembly (or hub-and-rotor assembly with disk brakes).

Each front wheel uses two bearing assemblies (an inner and an outer), two cups (also inner and outer), a dust cap, and a grease seal. A thrust washer, an

**In heavy-duty applications,** as with this police car, the front-wheel-bearing adjustment is usually made with a torque wrench, shown in use below. A typical wheel bearing requires 20 pounds.





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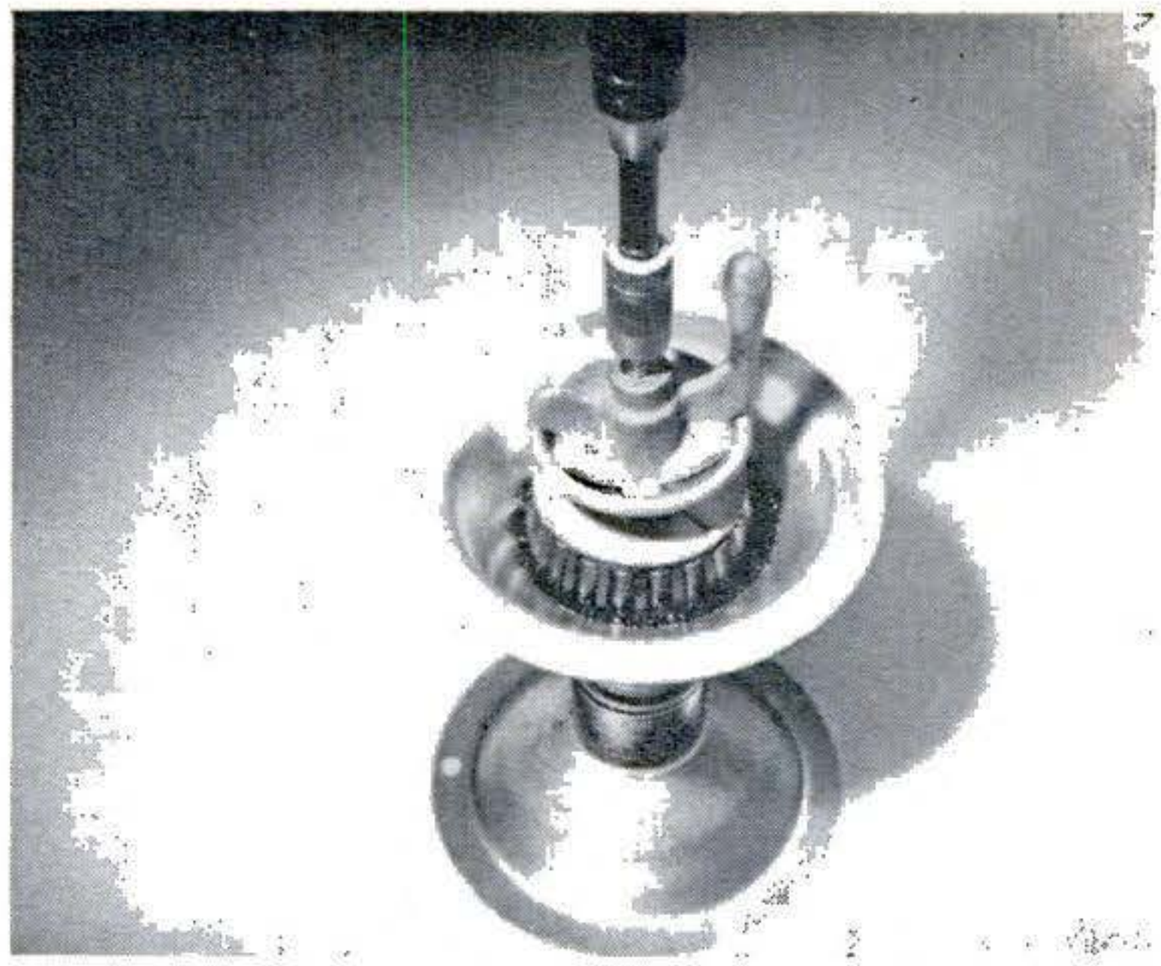
**Grease seal** should be installed so that it comes below the rim of the hub assembly (in most cases). The hub shown above has ball bearings; most late-model cars use tapered roller bearings.



**Wheel bearings** can be machine-packed with grease. While a clamp holds the bearing, grease is forced through the bearing from the inside. You can get this job done for $1 at most service stations.

adjustment nut, and a cotter pin complete the assembly.

**Removing a bearing.** Raise the vehicle on jack stands. Pry off the wheel cover or hubcap and remove the dust cap (grease cup) with a pair of water-pump pliers. Wipe grease from the spindle and remove the cotter pin. Then loosen the adjustment nut (and nut lock if used). Jar the top of the wheel with the heel of your hand to force out the thrust washer and the outer bearing. Remove the nut, thrust washer, and outer wheel bearing.

Place the bearing on a clean cloth or cardboard. Remove the wheel assembly. Don't drag the inner bearing and grease seal along the spindle threads. Raise the wheel slightly while removing it.

Place the wheel and drum assembly, dust cap down, on the floor. Use a large screwdriver to pry out the grease retainer. Do not re-use seals; they are likely to leak.

New seals should be soaked in clean engine oil for about 20 minutes before installation. This makes for immediate sealing and cuts the risk of contaminating the brake linings with grease.

Lift out the inner wheel-bearing assembly. *Do not* remove the bearing cups unless they require replacement.

**Cleaning.** Wash the bearings with solvent. Clean away all grease with a small paintbrush. Wipe the spindle clean with a soft cloth. Cover with cloth. Then wipe the hub and cups.

If compressed air is available, use it to dry the parts cleaned with solvent. Never spin dry bearings with compressed air. If compressed air is not available, dry with lint-free cloth.

**Looking for trouble.** Look carefully at the bearing rollers. Dirt is the most common cause of wheel-bearing failure. Damaged rollers will feel rough and will appear dull.

If previous adjustment was too loose, the small ends of the rollers will be flaked or spalled (chewed away). If previous adjustment was too tight, the large ends of the rollers will be flaked, spalled, o worn away at a sharp angle.

Hairline cracks in the cones mean they were forced on too small a spindle; or it could mean the cups were canted slightly when they were installed. In severe cases, the hub could be warped.

Overheated bearings will be bluish in color. Burning comes from too tight an adjustment or lack of lubrication.

Cup damage is usually limited to pitting and roughness caused by dirt or brinelling, which is a series of lines or indentations across the face of the cup. Brinelling often results from severe shock loads, such as striking a bump or pothole at high speeds. Any of the above conditions requires bearing and cup replacement.

**Cup replacement.** Use a hardwood dowel or brass punch to drive out the cups.

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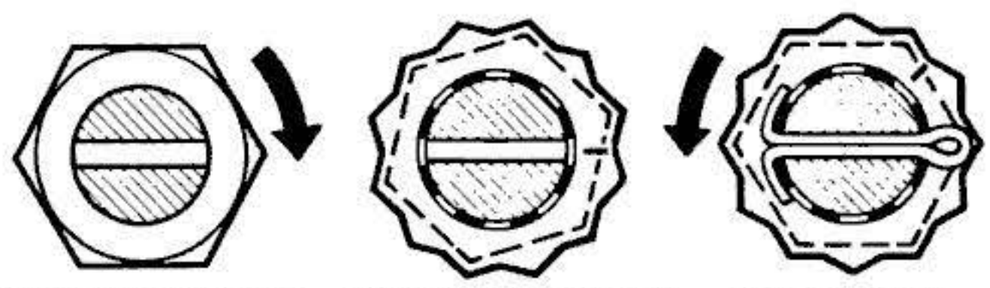
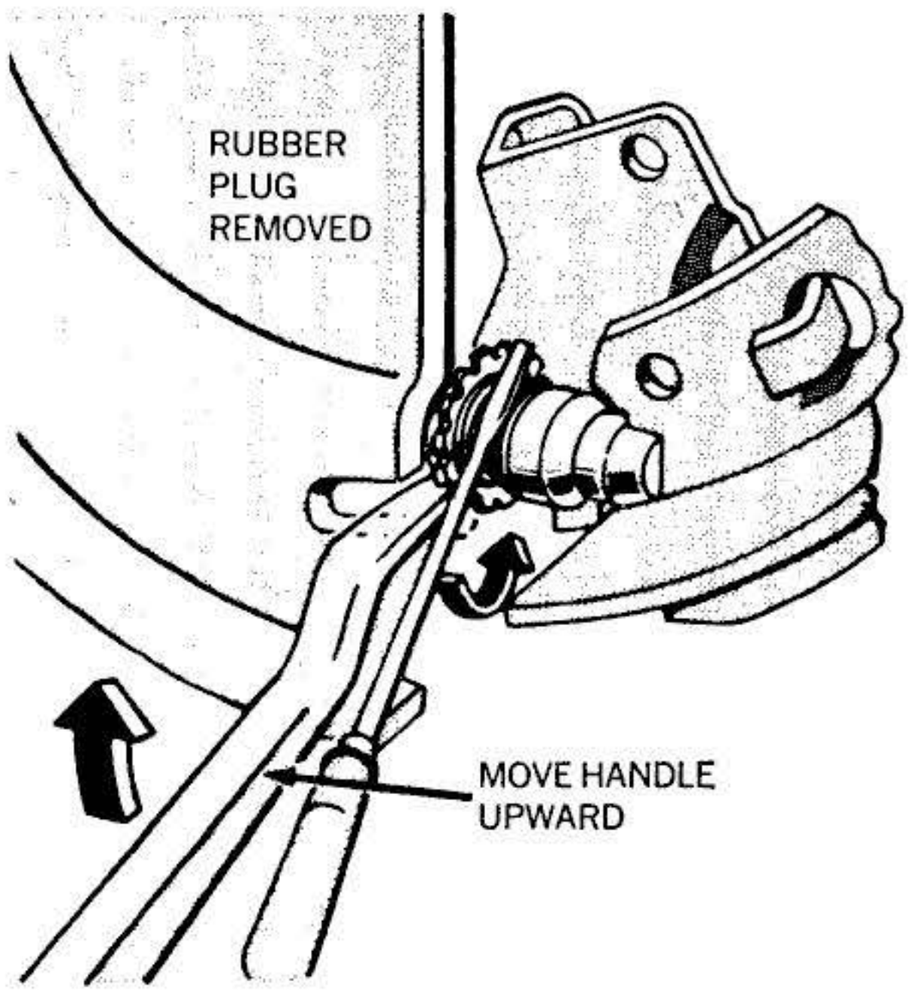


WITH DRUM AND WHEEL ROTATING, TORQUE ADJUSTING NUT

INSTALL LOCK ON NUT SO CASTELLATIONS ARE ALIGNED WITH COTTER-PIN HOLE

BACK OFF NUT AND NUT LOCK ONE CASTELLATION; INSTALL COTTER PIN

**Bearing adjustment** starts with tightening of the nut while the wheel is rotating. This seats the rollers. Then back off to get proper tolerance, usually between .001 inch and .005 inch.




**On front-wheel brakes** with automatic adjusters, insert an icepick through the adjustment slot to lift and hold the lever off the star wheel. Moving the tool upward loosens brake adjustment.

| FAILURE CONDITION | INDICATION AND CAUSE |
|---|---|
| **Brinelling** | Small indentations in cups and/or cones. Caused by sudden road shock or impact loads. |
| **Flaking or spalling** | Wearing away of roller material. Too loose an adjustment wears big ends of rollers. Too tight an adjustment wears small ends of rollers. |
| **Overheating** | Straw-brown, ink-blue, or purple discoloration of rollers, cups, or cones. Occurs at temperatures above 300°. Caused by lack of lubrication, too much lubricant, breakdown of lubricant, or overtightening. |
| **Rust** | Reddish-brown, black, or dark-gray pitting, etching, or staining. Caused by handling bearings with moist hands, a defective seal, or faulty seal installation. |

Tap each cup at several points to drive them straight out of their bores.

To install new cups, use one of the old cups as a driver. Position the new cup carefully in its bore. Lay on the old cup and tap the new cup home. You'll know when the cup is properly seated by the solid sound it makes when it contacts the internal shoulder.

**How to pack a bearing.** Wheel-bearing grease is either lithium-based or sodium-based. Greases of different base cannot be mixed—that's why it's so important to remove all traces of old grease when cleaning. Each type works fine. They just aren't compatible with each other.

Grease must be packed into the bearing assembly. Most service stations have machines that force grease through the assembly. That costs about $1. Bearings can be hand-packed sucessfully, if you take time to work grease thoroughly in. It's not enough to spread a coating of grease around the outer surfaces. One trick is to put grease in a small plastic bag, drop in the bearing, and knead it.

**Assembly.** Install the inner bearing and the wiped-dry grease seal. Tap the seal at several points with a wooden dowel until it is about 1/8 inch below the outer rim of the hub. Coat the spindle with a film of grease. American Motors, Ford, and Chrysler recommend filling the hub cavity with grease, level with the inside diameter of the inside bearing. GM wants the spindle and cups lightly greased, but doesn't recommend filling the hub cavity. Install the wheel assembly, then the outer bearing, thrust washer, and adjusting nut.

**Bearing adjustment.** While rotating the wheel, tighten the adjustment nut until all play is about right. Back off the nut one flat (1/16 to 1/4 turn) and install the cotter pin. If a nut lock is used, install before the pin. Specifications vary, but tapered roller bearings should have zero to a few-thousandths-inch end play. Check with a dial indicator, if available.

Install the dust cap and wheel cover (or hubcap). Adjust the brakes, if they were loosened. On automatic adjusters, rotate the wheels rearward while pumping the brake pedal.

After you've gone through this, step by step, your wheel bearings won't need any attention for another year. PS



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## WHAT'S NEW FOR THE HOME

### Have a close shave for Christmas

Remington's 800 Quick Charge cordless electric shaver recharges for use in a matter of minutes. Its four dial positions adjust to suit the user no matter what the skin/beard combination. Designed for home, office, and travel, the shaver was chosen by the National Design Center as one of 1968's best-designed home-use products. About $30.

### That's a switch for night lights

A tiny control that automatically turns lights on and off can be used with lawn, porch, flood, and interior lights. Called Watchbird, the device has a light-sensitive photocell that turns on the light when outdoor illumination drops below two foot-candles; at daybreak, action is reversed. $9. Wagner Elec. Corp., Newark, N. J. 71268.

### This spiral stairway comes in a kit

Furnished in subassembled components, Studio Stair can be ordered to suit the exact height you need, in one of four diameters. Prices begin at $195, including clear-oak treads, railings, platforms, and installation instructions. American Panel Products, 1735 Holmes Rd., Ypsilanti, Mich. 48197.

### Mediterranean-style doors for inside the home

Created to reflect the elegance of Spanish design, Toreador interior doors feature 1 5/16-inch-thick panels for deep architectural shadow lines. Available in five widths, all doors come six feet, eight inches high. For spec sheet, write Ponderosa Pine Woodwork, 39 S. LaSalle St., Chicago 60603.



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**Power unit** is simple box built from scrap to house small transformer and silicon rectifier. Cord at right plugs into wall outlet. Center cord (from rectifier) is positive, clips to work; one at left, to stencil pad.

# Make an Electric

## You use a common mimeo stencil, but the printing agent isn't ink —it's an electrochemical flow

By ROLAND LOEWEN

You can easily—and safely—put electrochemistry to work "branding" your name on tools, or decorating aluminum sheets. The stencil pad consists of a metal plate (copper, aluminum—even a scrap of tin can) covered with felt that's saturated with a solution of table salt (or with liquid Sani-Flush).

Over this pad you smooth a section of an ordinary mimeograph stencil (available at any office-supply store) which you have typed on a typewriter set for stencil cutting, or with a hand stylus—just as if you were preparing it for inking.

Clip the leads from a DC power source to the stencil pad and the workpiece and press the two together for 10 to 90 seconds. This power source can be your auto battery, a battery charger, or an electroplating unit. Or, to use house current, you can easily assemble a unit costing under six dollars from a small transformer, a silicon rectifier, a few feet of insulated wire, a male plug, and two alligator clips. The power needed is at only six to 12 volts low amperage. I use a filament transformer from Allied Radio (their stock number 54C1420) that's rated 110-120 volts primary, and 12.6 volts at two amps secondary. I get about 12 volts, which speeds up etching jobs.

I made two types of stencil pads—a one-liner to hand-hold against tools and a block against which metal plates can be pressed. Both are sketched at right. For the one-liner, glue the metal plate to the slightly rounded edge of the wood strip with epoxy cement, letting it extend at one end and bending it up as shown for attaching an alligator clip. Fasten a strip of felt over the metal, gluing it lightly.

To use, soak the felt in the salt solution, then dab with a cloth to remove excess. Center stencil over felt so the lettering is backwards as you look at it. Tuck ends under a big paper clamp. The larger rig has two spring-loaded bars for this purpose; they seat in rabbets. Be sure your stencil is large enough to cover the felt or you'll leak current at the ends.



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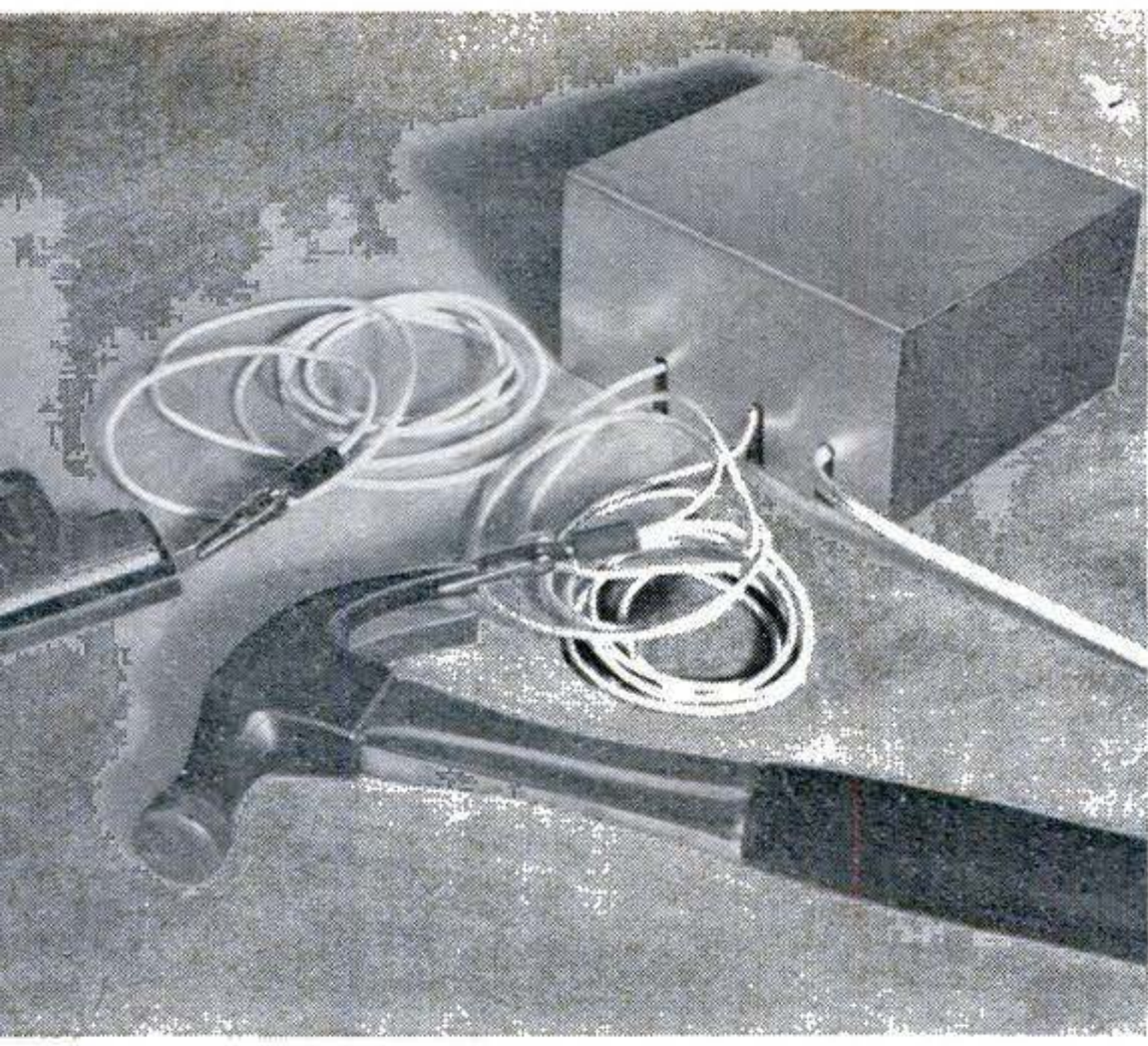
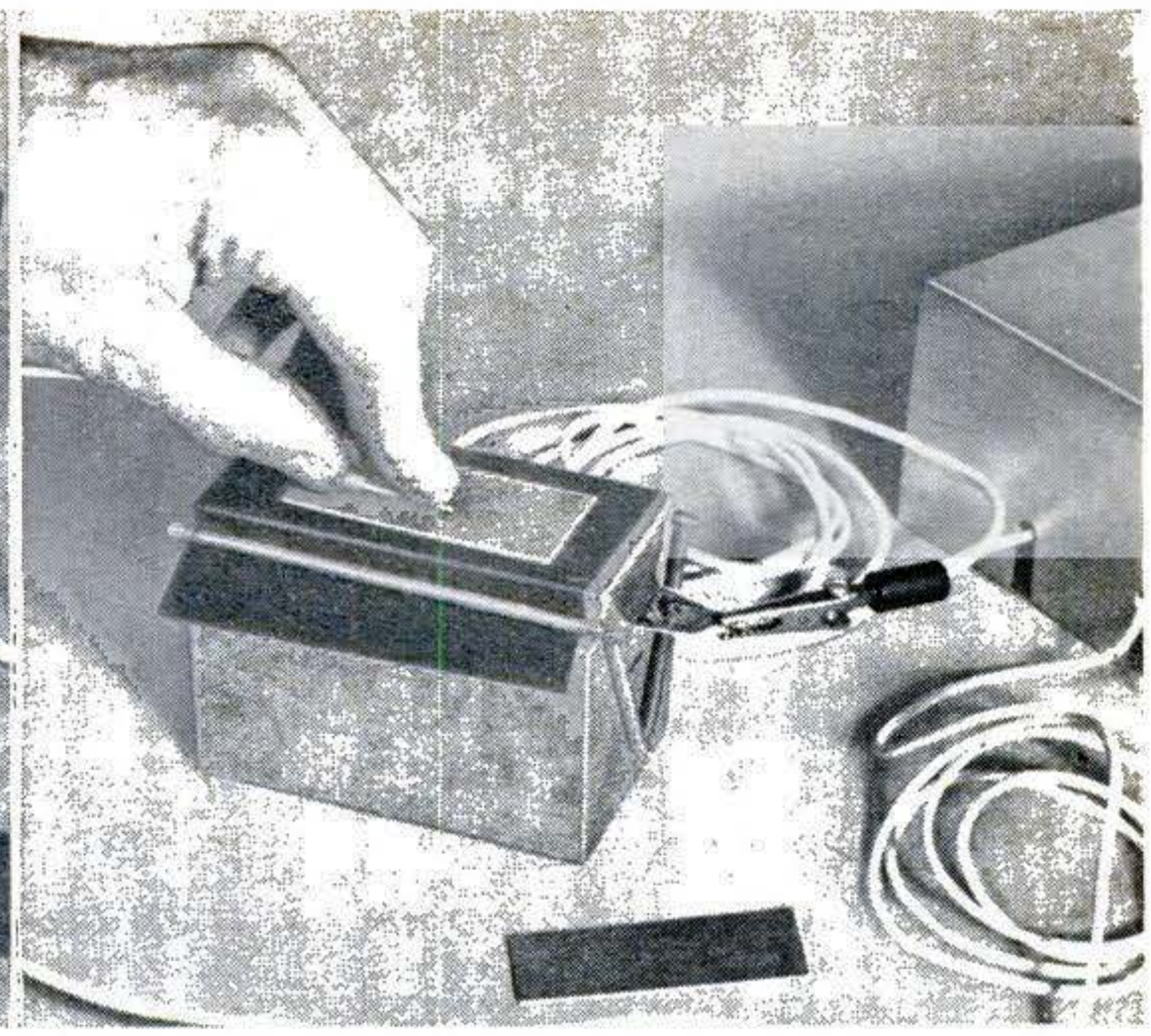
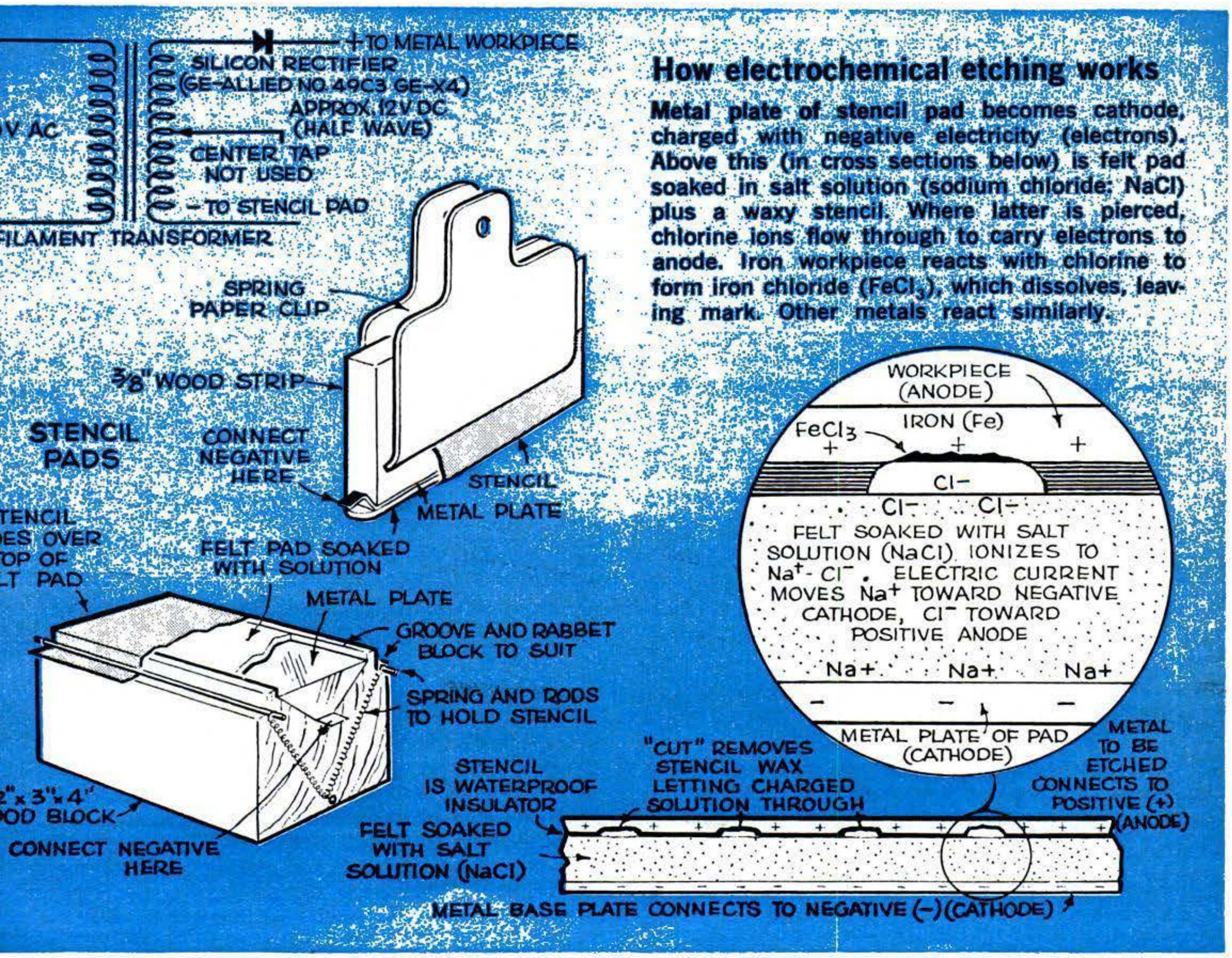




**One-line stencil pad** (left) is secured by spring clamp, as shown in sketch below. It's fine for applying name to hammer (above, with clip applied) or to steel punch and chromed tape case (far left, facing page).

**Block-type stencil pad** offers etching area about 2½" by 4"—ideal for address plates shown above. You induce electrochemical flow by holding positive clip in contact with back of plate centered on stencil.

# Stencil to Etch Metal




## How electrochemical etching works

**Metal plate of stencil pad becomes cathode, charged with negative electricity (electrons). Above this (in cross sections below) is felt pad soaked in salt solution (sodium chloride: NaCl) plus a waxy stencil. Where latter is pierced, chlorine ions flow through to carry electrons to anode. Iron workpiece reacts with chlorine to form iron chloride ($FeCl_3$), which dissolves, leaving mark. Other metals react similarly.**



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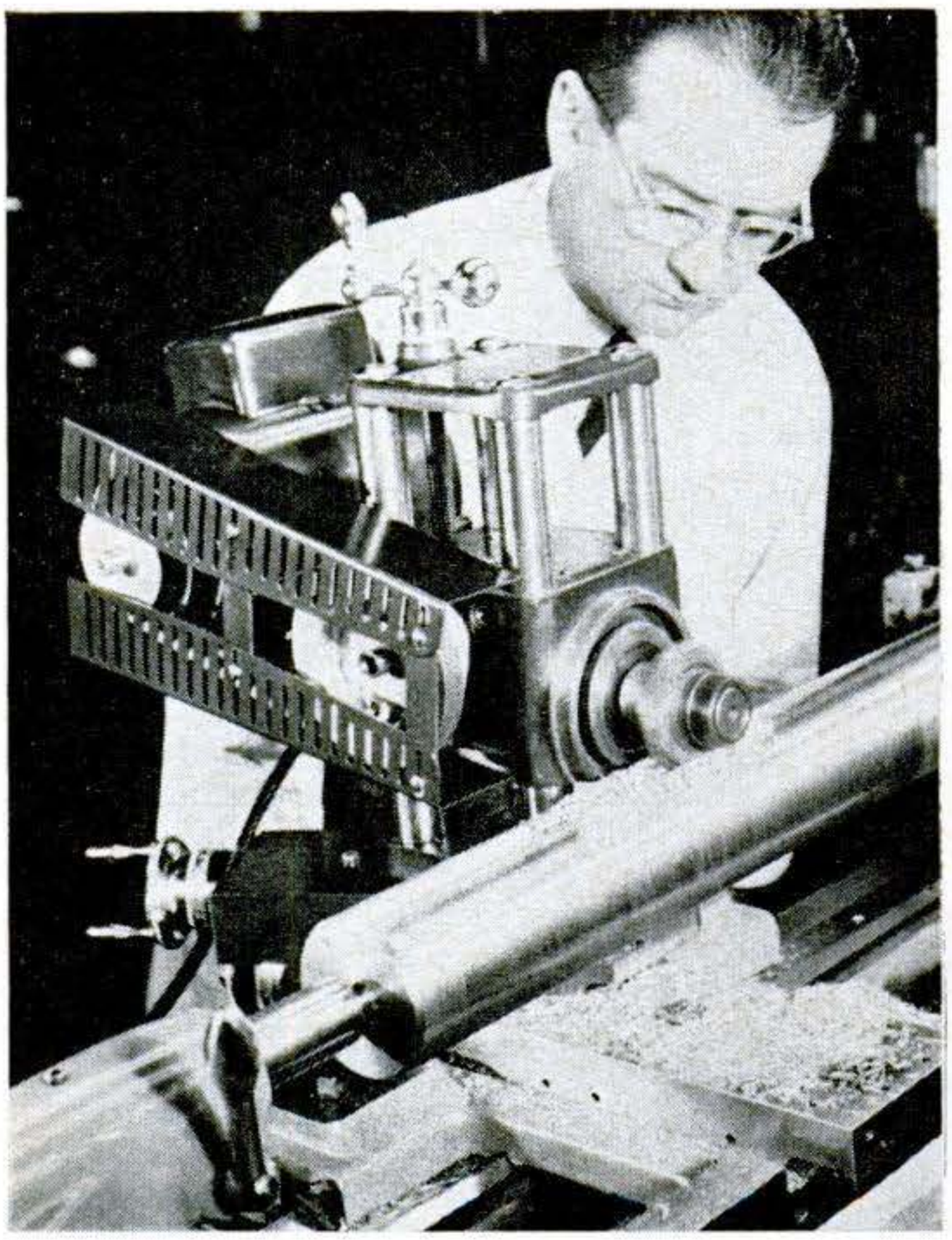
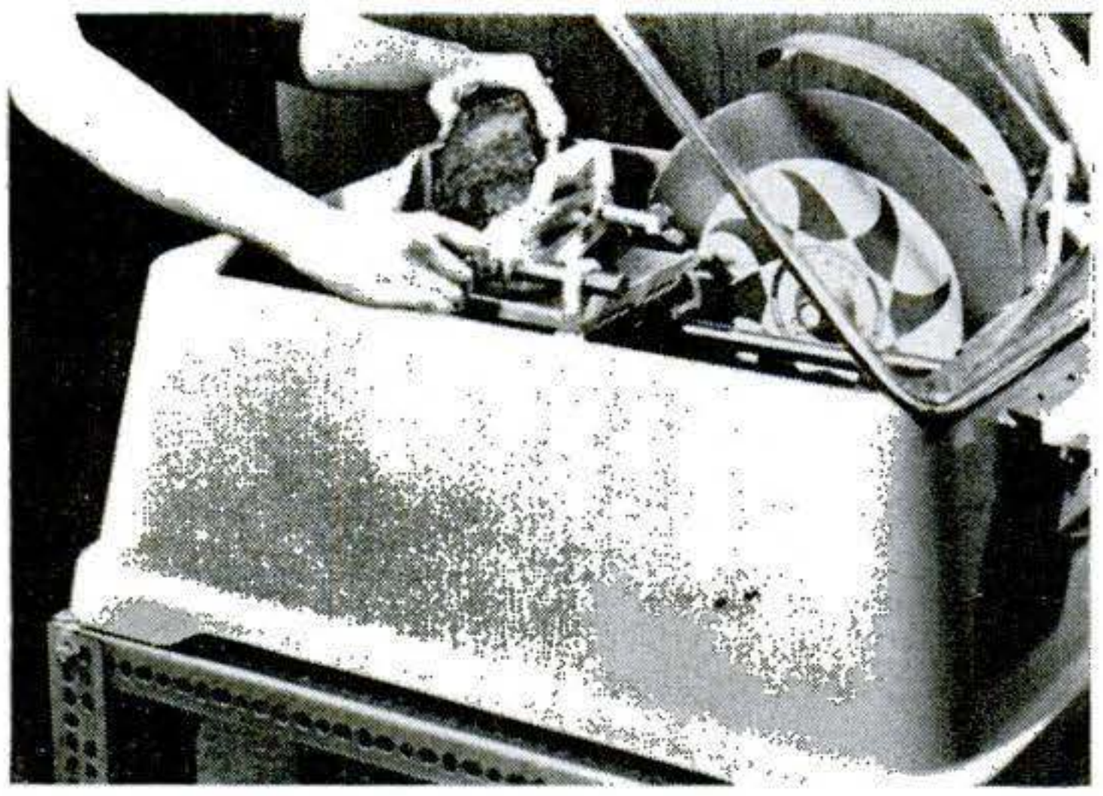
# WHAT'S NEW IN

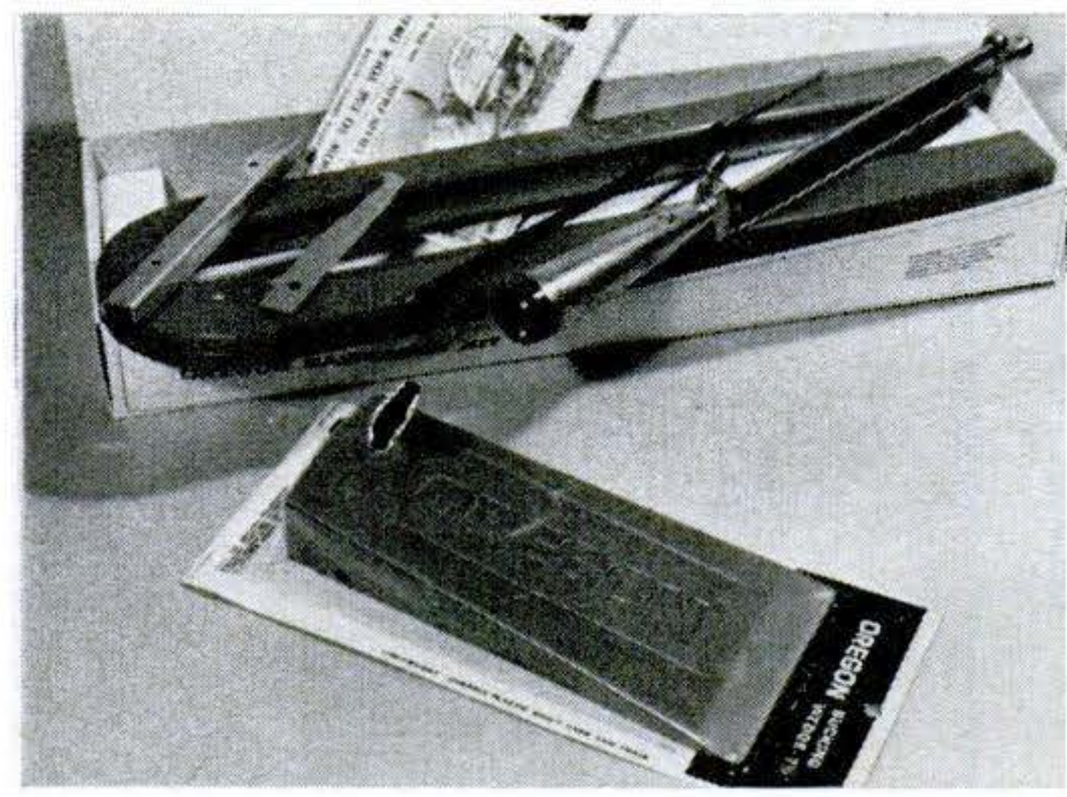


**Versa-Mil portable machining unit** lets you get more from your engine lathe; built-in power and vertical feed enable you to mill, drill, slot, bore, shape, and grind. With two-directional-feed table—one of many accessories—unit becomes a complete machining tool for use on the bench or for in-place machining of parts too large to be moved to conventional machine tools. Available in three sizes for light, medium, and heavy jobs, basic units are priced from $530 to $595. Dumore Co., Racine, Wis.

**Abrasive finishing machine** from Rockwell combines a 6" belt unit with a 12" disk sander. The rig, which has two tilting tables, moves the belt at 3,450 f.p.m. and the disk at 2,400 r.p.m. Level work surface is always available when using belt component—with or without tilting table—because belt can be adjusted quickly from vertical to horizontal, or locked at any angle in between. An external dust collector is an optional extra; two outlets on the stand fit 2½" hose. Basic list price is $195.



**Lapidary slab-trim saw** uses recirculating coolant to carry away the cut stone particles, doing its job neatly enough to be used in the home, claims the maker. To prevent spattering, the top of the machine is enclosed with a plastic cover that can be removed and wiped off or washed clean for clear visibility. Hillquist Lapidary Equipment, Inc., 1545 NW 49th St., Seattle 98107 ($265, f.o.b. Seattle).




**Oregon Sawsaver kit** permits do-it-yourself chainsaw maintenance to improve performance and prolong the life of the parts. It can be used on all chipper-type chains of ⅜" and .404" pitch. The kit includes two files, file holder, bar scabbard, cutter-depth measuring device, bar-groove cleaner and wedge, plus instructions for use. $8.15 at saw dealers. Omark Industries, Portland, Ore. 97222.



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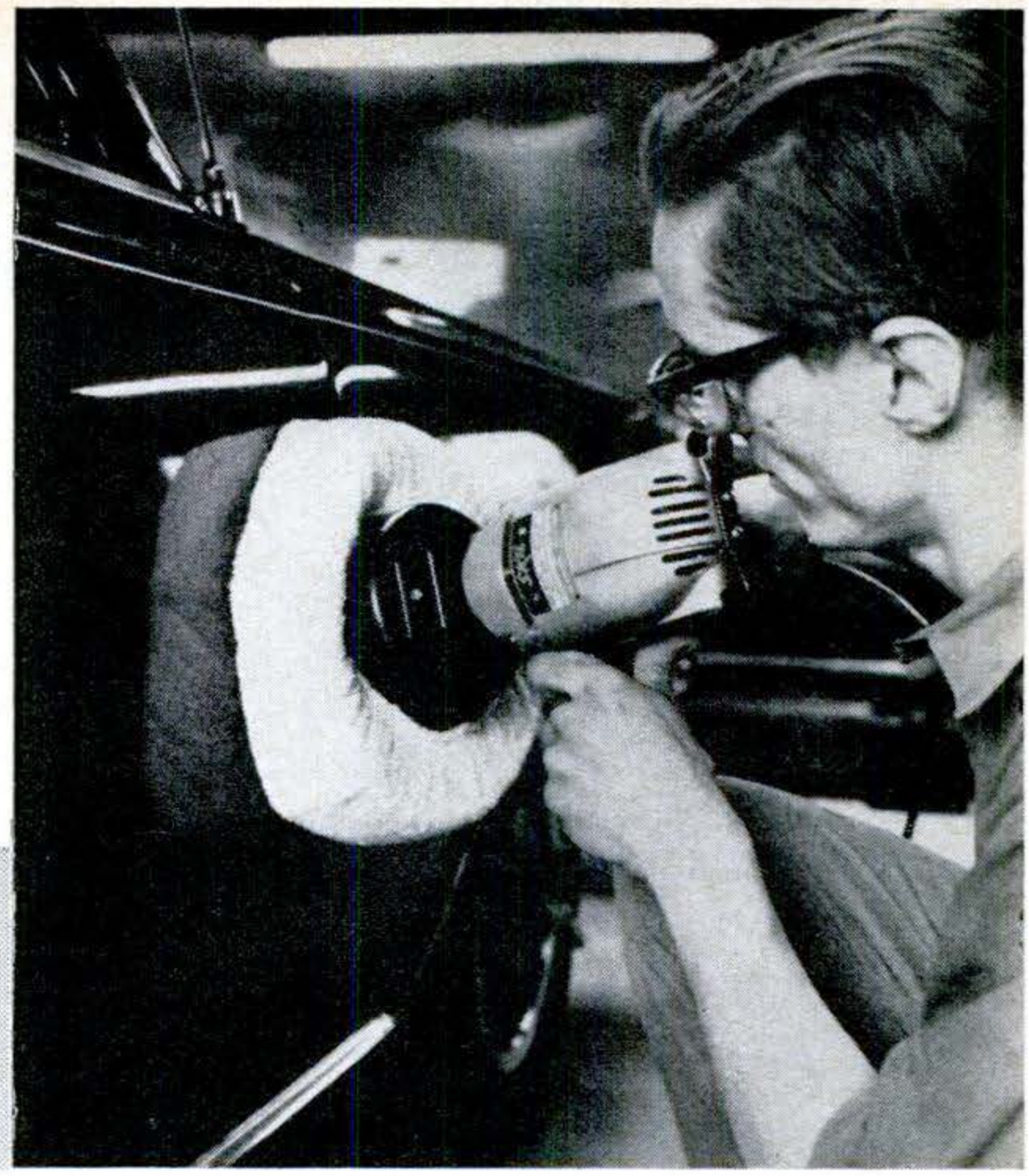
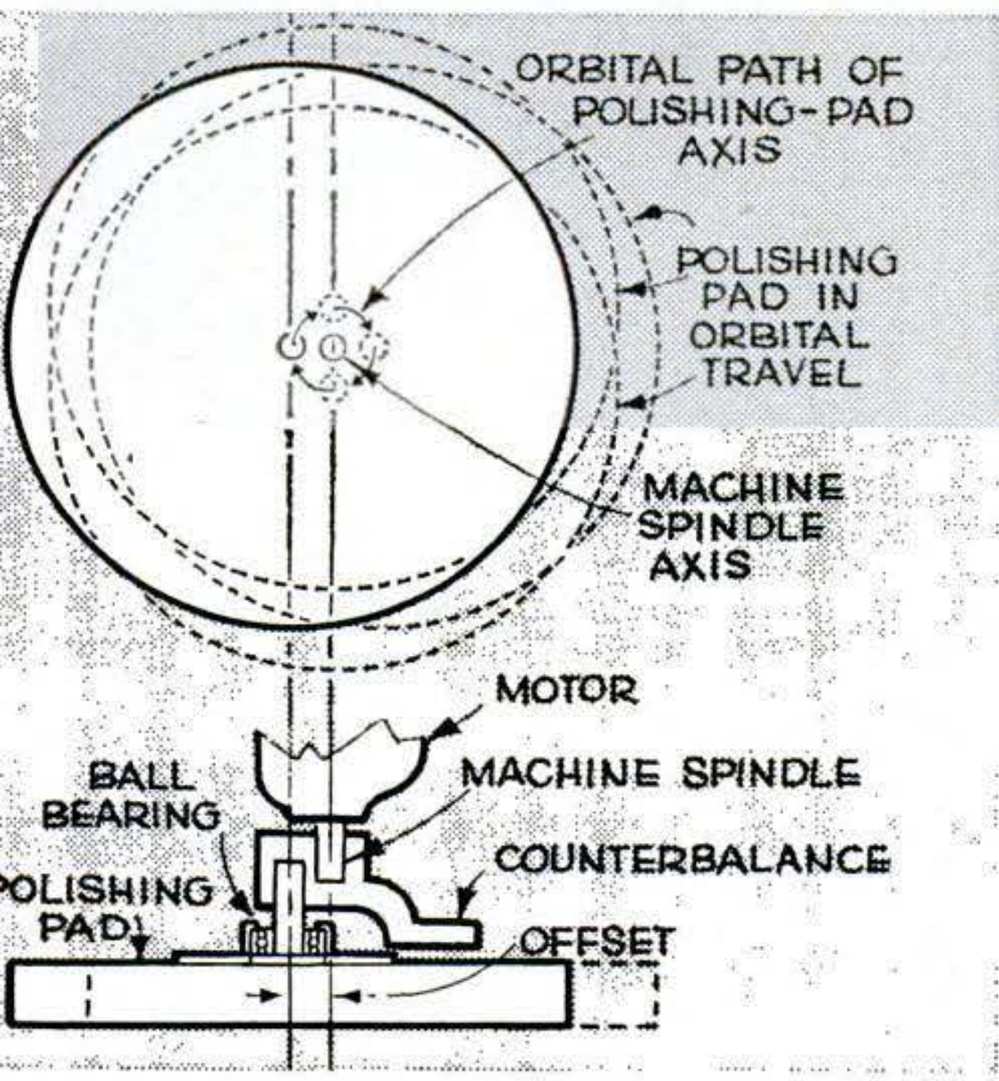
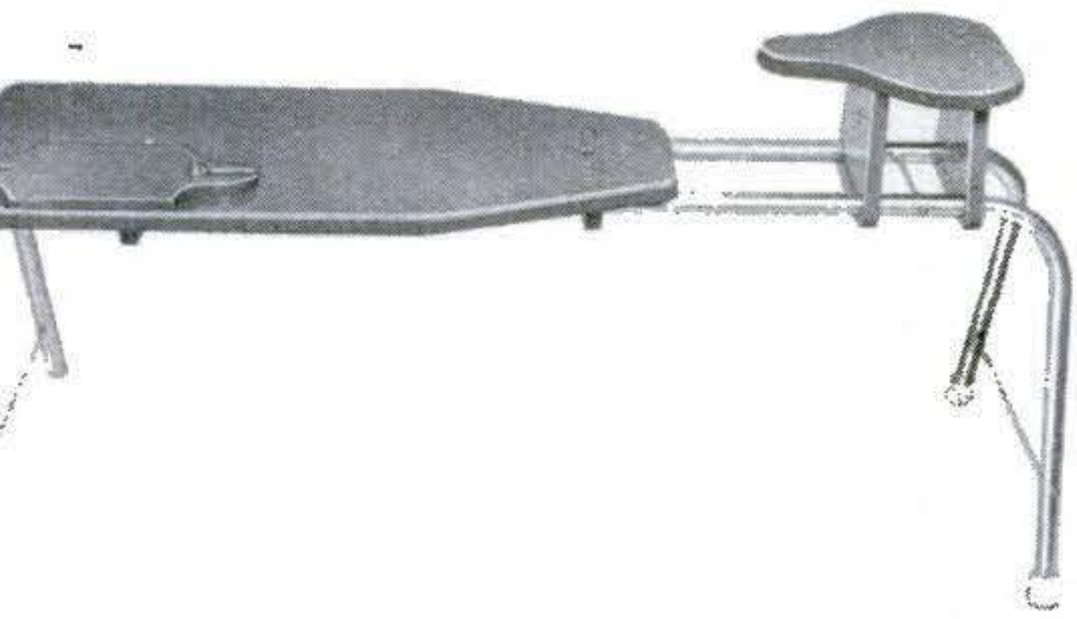
# TOOLS

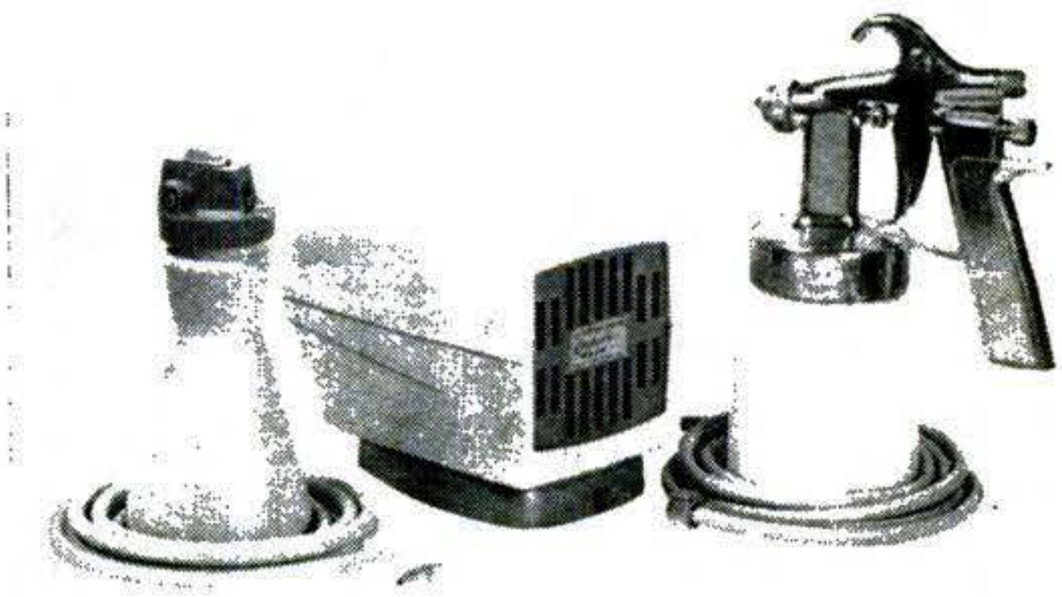





**Heavy-duty Roto-Orbit polisher** from Skil is said to bring significant improvements to the waxing and polishing of cars and other painted or aluminum surfaces. Unlike conventional rotating polishers, the Model 1125 adds orbital action (see sketch at left). Pad is positively driven in orbital path by the machine spindle, yet is free to rotate at random on its own offset shaft. The result is a swirl- and scratch-free finish with no danger of burning the work surface. The 5.5-amp heavy-duty motor that pushes the 10½" diameter pad at 1,500 r.p.m. has Skil's exclusive super-burnout protection. The $119.50 price includes two terry-cloth bonnets and a foam-rubber backing pad.



**Portable workbench** for use with B and I's pottery wheels and gem makers provides comfortable, uniform working position. Made of 1" zinc-plated tubing, it is 50" long overall and has adjustable motor-mounting board. The seat is 24" from the floor; height to the 15"-by-31¾" work surface is 19". Easily assembled, the bench is $32.50 f.o.b. from B and I Mfg. Co., Burlington, Wis. 53105.



**Now: a "his and hers" spray outfit:** The heart of the Galaxie Mark I is a diaphragm-type compressor powered by a GE motor. His gun, of cast aluminum, has an internal mix nozzle adjustable to a 6"-wide spray pattern. Her gun, with plastic spray head, has fingertip control for such jobs as spraying mothproofing, waterproofing, insecticides. $19.95; Thomas Industries, 207 E. B'way, Louisville, Ky.



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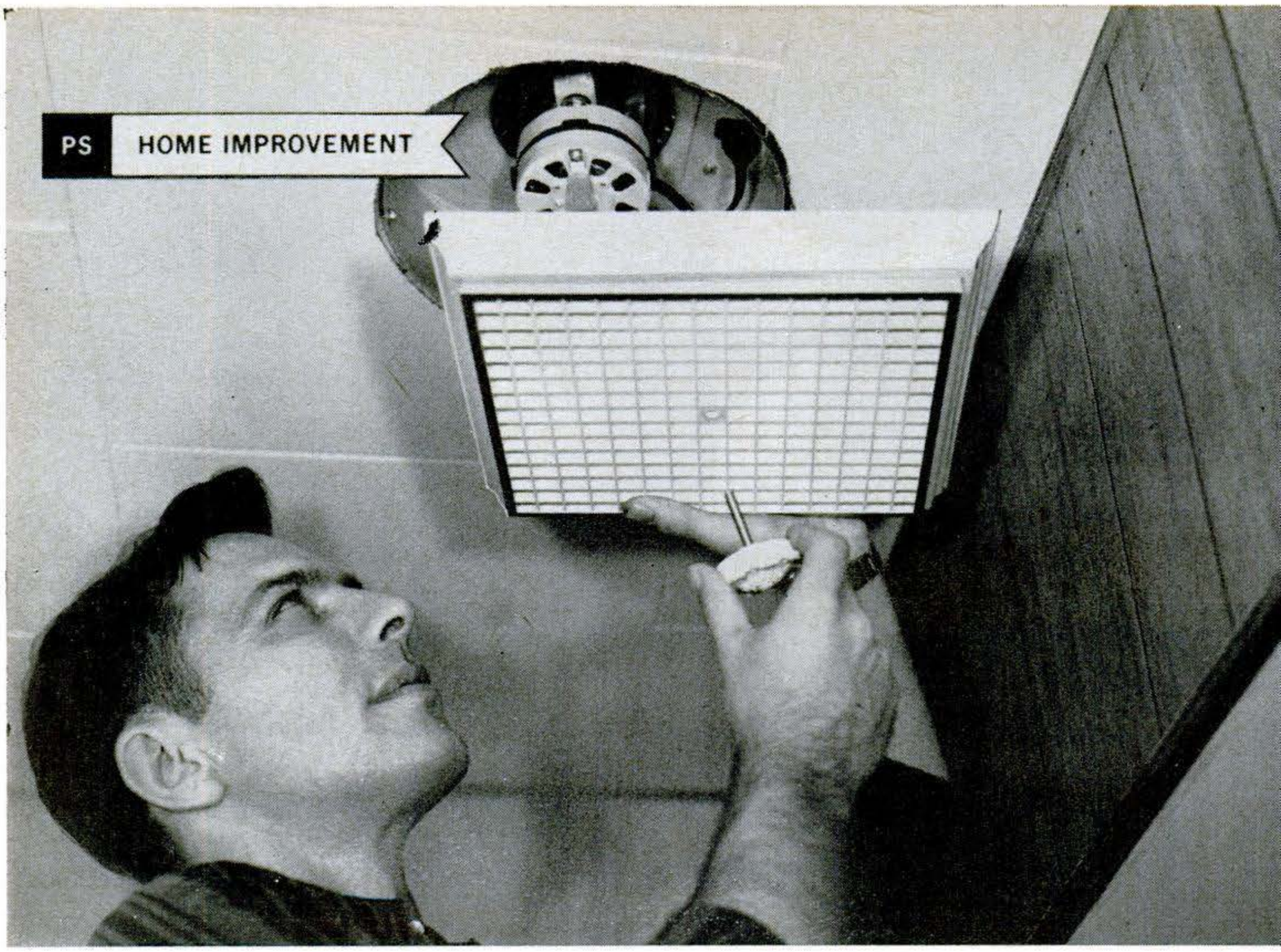

# How to Install a Vent Fan

Time was when bathroom exhaust fans were pretty much a luxury—nice to have, but not essential unless the bathroom was windowless. But houses have tightened up. Central air conditioning, forced-air heating, heavy insulation, and year-round storm sash have made the bathroom fan a necessity in many homes —for both ventilation and the removal of moisture.

You can install one for the price of a modest or posh evening on the town. Doing it yourself, a simple bathroom fan can be put in for as little as $25. If a contractor installs a fancy three-speed unit, complete with light, heat lamp, and timer, the job could run as high as $100. Many models are available, but basically they're all grille-enclosed, metal-housed, bladed fans (or squirrel-cage blowers), driven by a tiny AC-DC motor. Exhaust is via a round or rectangular duct and a dampered outside cap on a wall or roof.

**What makes a good vent fan?** Appearance, certainly, but that nicely styled grille (the only part you see) needs looking into. Make sure it is moisture resistant. Ease of cleaning is important, too. You will have to clean it several times a year; don't pick a fan that makes this job a chore. And quiet operation is a prime consideration. Try out several fans in the store. With the motor running, touch the frame to check for vibration caused by poor balancing.

Consider the extras. A model with a light may add $10 or more to the price. But it's worthwhile if you need additional lighting. A heating element or pair of infrared bulbs will increase cost about $20. A timer—which requires extra wiring—adds still another $10.

FHA regulations require that a bath vent change the room air eight times an



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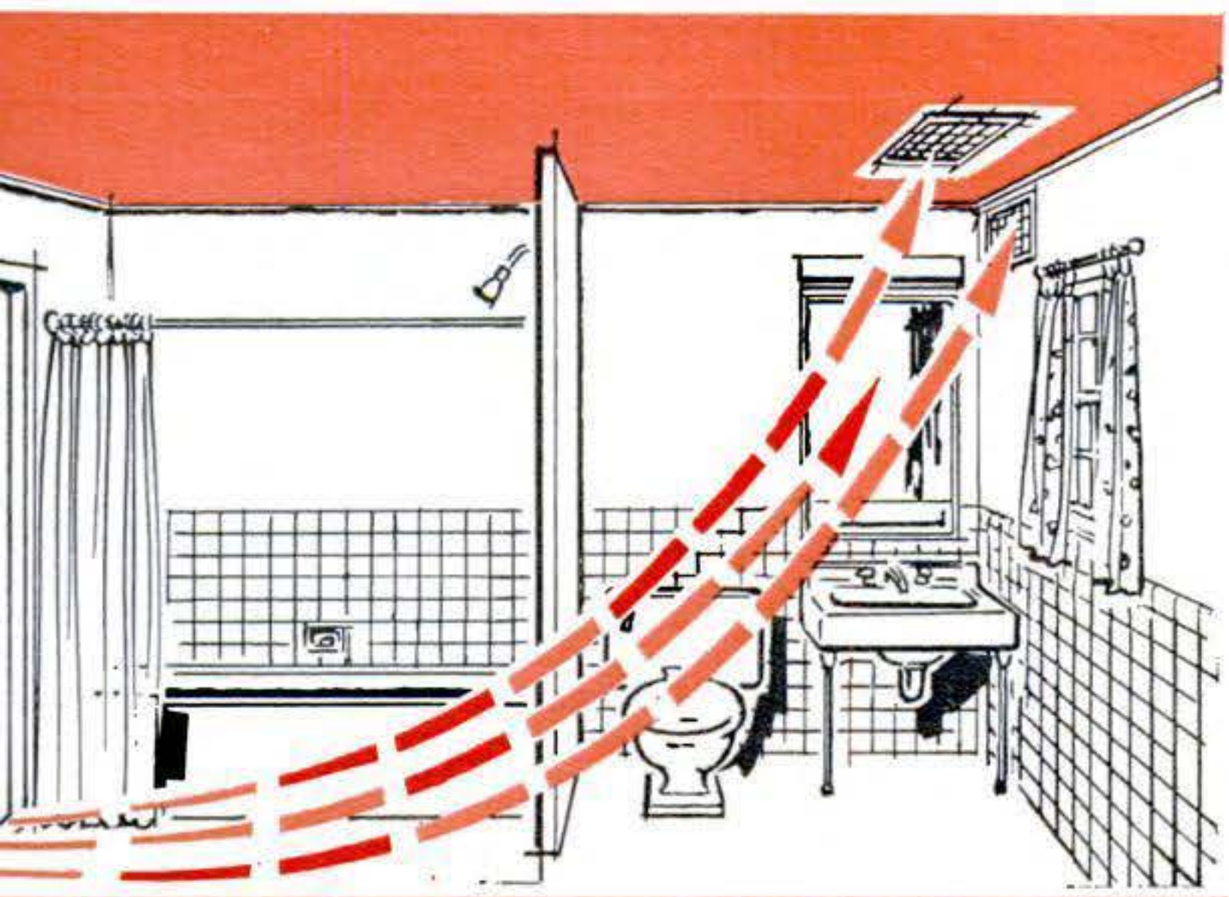


**"Make-up air" comes in under the door.** For maximum efficiency, exhaust fans should be unobstructed, placed on ceiling or high on wall. Electric code prohibits placing fan over enclosed shower or tub.

**How Large a Fan Do You Need?**

| Room Area in Square Feet (eight-foot ceiling) | Fan Air Delivery Needed (cubic feet per minute)* |
|---|---|
| 50 | 60 |
| 75 | 90 |
| 100 | 110 |
| 150 | 165 |

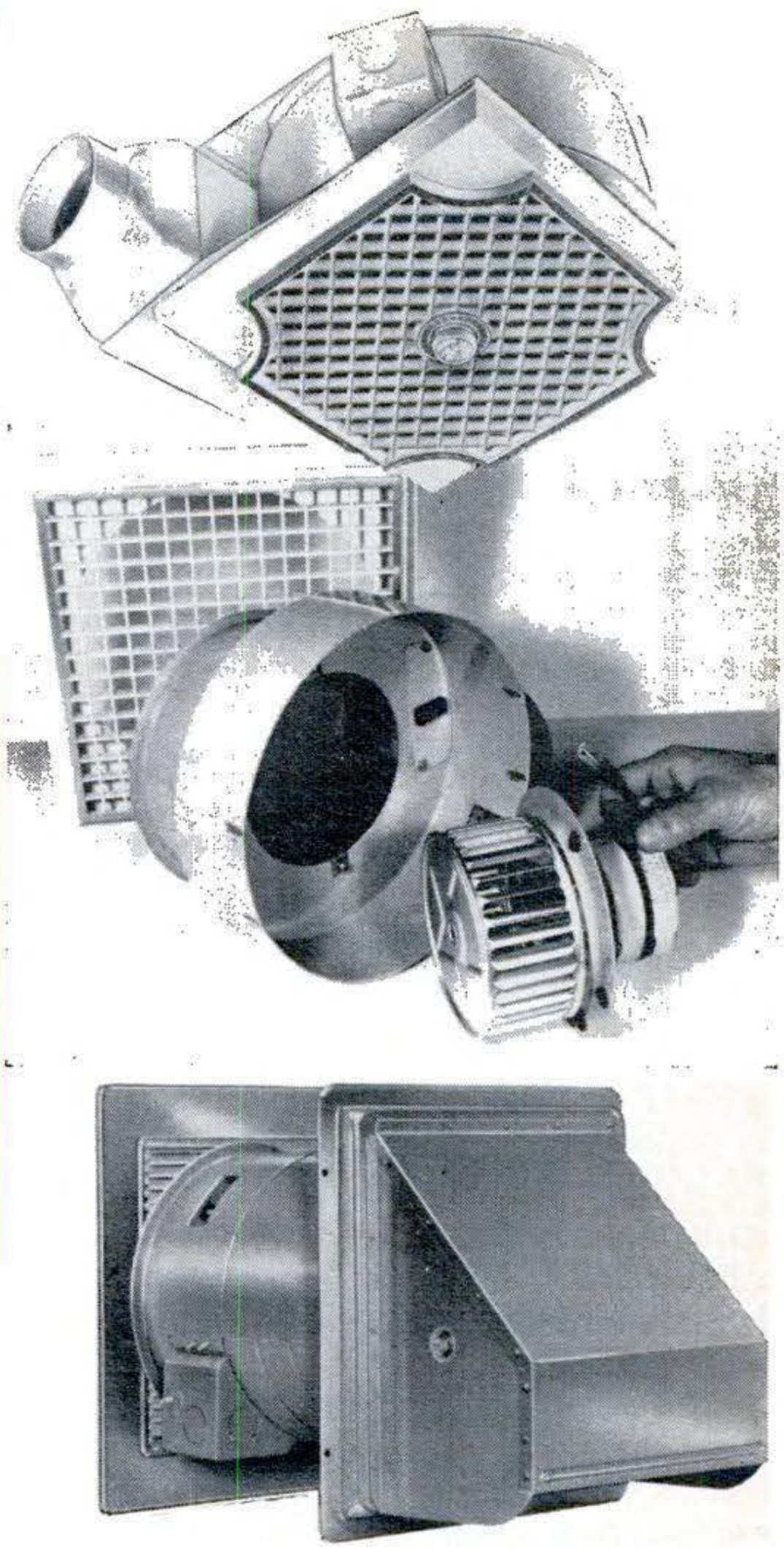
*Deliveries shown provide eight changes of air per hour; figures are approximate, based on normal installations.

# in the Bath

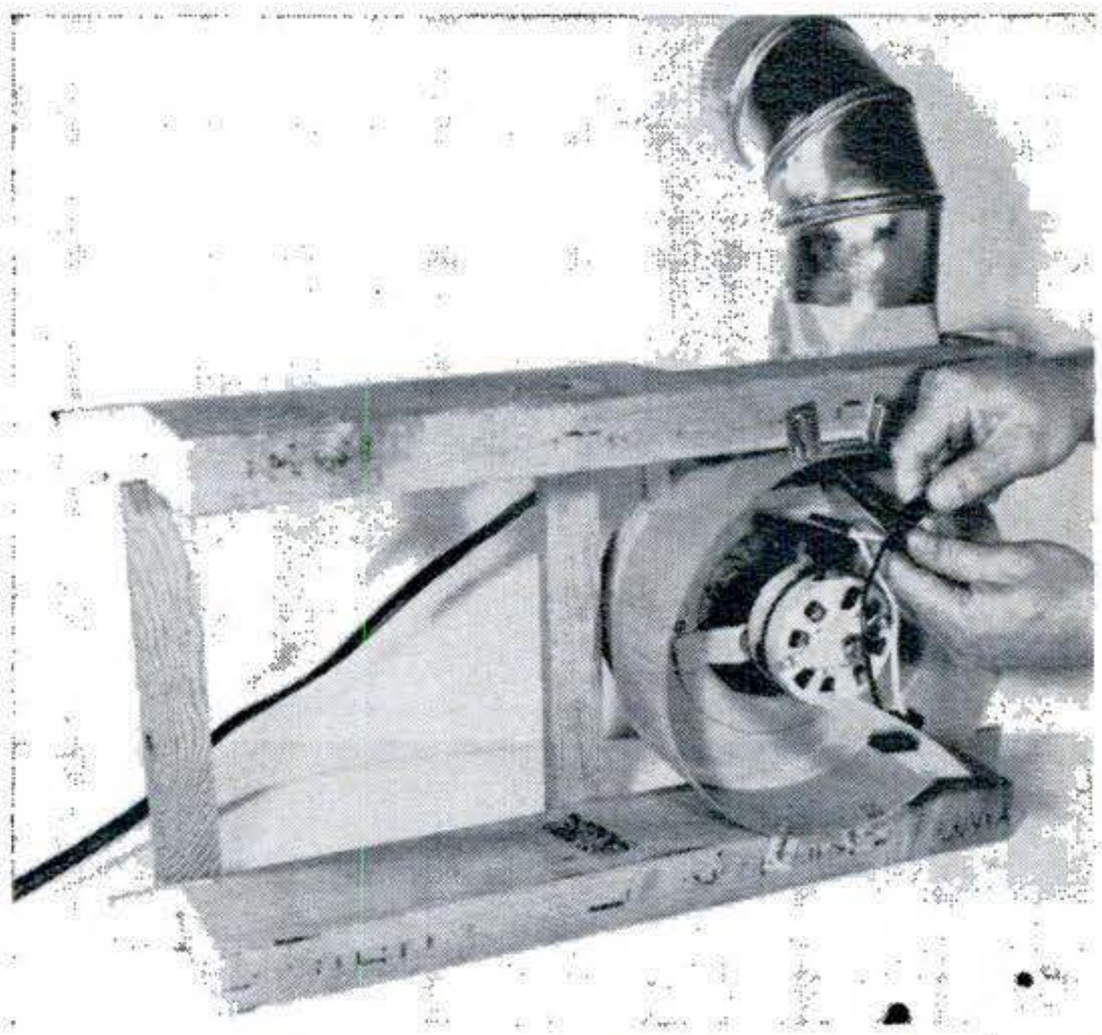
hour. Fan specs certify air delivery in cubic feet per minute (c.f.m.); they range from 50 to 200 c.f.m. or more. Use the chart to determine how large a fan your bath requires. Finally, a good fan also includes a built-in junction box and a damper on the outside cap to prevent backdraft.

**Choosing for your situation.** Where to install a fan depends on how your home is constructed. Brick or stone walls more or less dictate a ceiling installation because of the difficulty of cutting a neat hole. But for a bath on the first floor of a two-story house, a wall exhaust gives fewer ducting problems. If your situation makes the decision a toss-up, consider the ceiling fan your first choice; a fan in-

*Continued*



**Tucked behind attractive grilles,** two Leigh fans (top photos) hide quiet-running squirrel-cage blowers. Nutone's wall fan, just above, has telescoping sleeves to fit walls five to 10 inches thick.



**Preassembly** of framework, wiring, and ductwork speeds up job if attic is cramped for work space.



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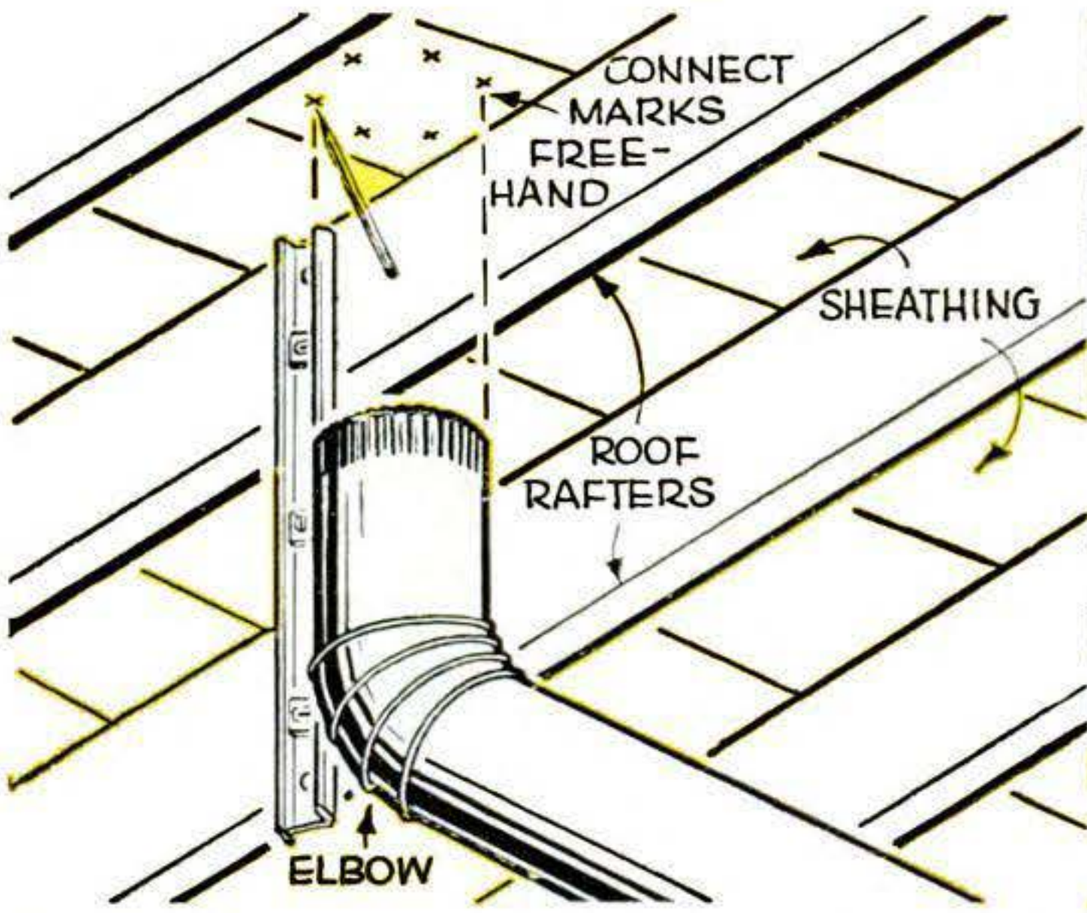
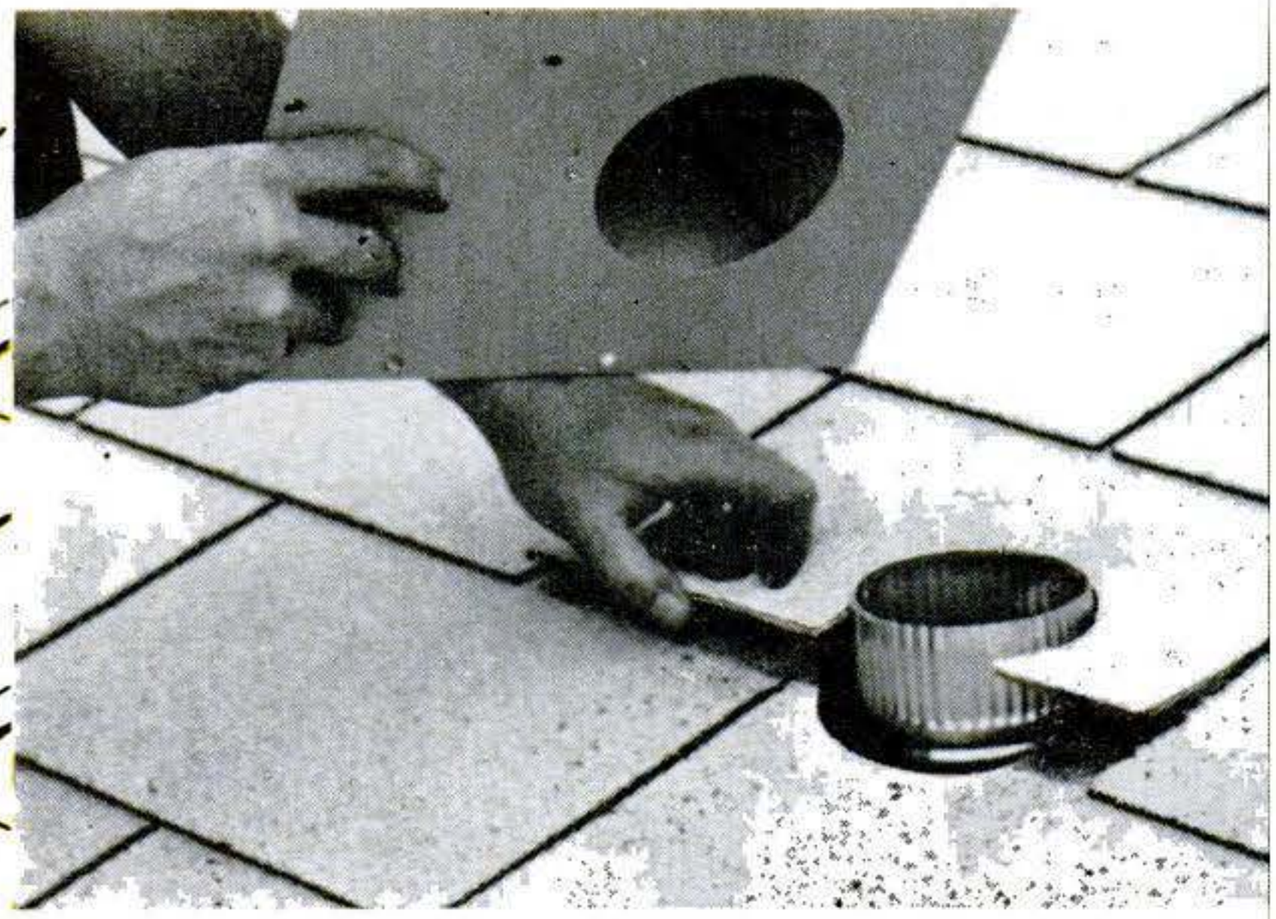
# How to cut the hole in your roof and insure a leakproof fan




**Hole for ductwork** is located by plumbing up from elbow with a level. Four or five marks spot the hole.



Roof jack with damper, rain hood, and animal screen is anchored to roof (nails are okay; screws are bet-

stalled high on the outside wall second-best for you.

It is legal to exhaust a bathroom fan into a vented attic—and it's frequently done. This is by far the least desirable method and should be avoided if you have any doubts about the adequacy of the attic's venting. Exhausting through the wall is a better solution.

**Installation.** Study the construction of the fan and determine how large a hole you should cut (some makers include this information on the instruction sheet). Most ceiling fans come with hanger bars packed in the carton. These are used in houses under construction and can be discarded.

You'll have to box out between joists to provide a solid base for mounting the unit. Or, it may be possible to shim the fan between joists with wood blocks. Some fans have side brackets that permit nailing against the side of a joist. Through-the-wall models contain the installation hardware.

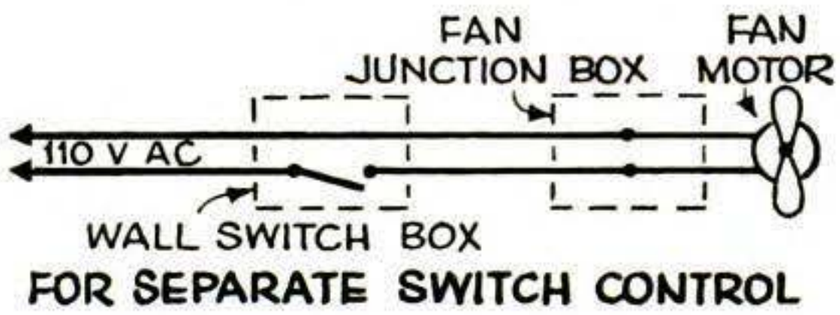
Before you cut the hole, make sure you won't hit any wiring or pipes. Locating the exact position between studs for through-the-wall installations may be easier from the outside. Once located, drill a hole through to pinpoint the center of the inside cut.

**Wiring.** If you have an attic, your best bet is to hook the fan into the wall switch of the room's ceiling light. A wall installation requires snaking new wiring inside the wall. Either way, you must comply with local codes governing vent-fan installation.

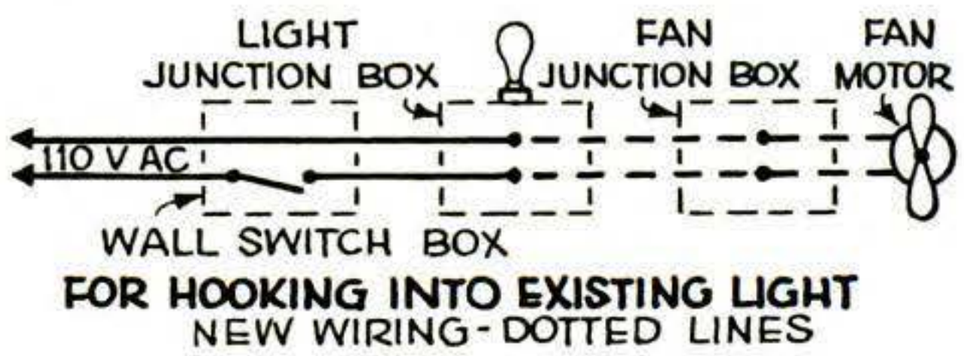
Wire the unit, following the schematic. If metal conduit (BX) is not required in your area, use at least No. 14 flexible insulated cable. (Heater-fan units may specify heavier wiring.) Be sure that power is off while wiring and, if the job appears beyond your skills, have a licensed electrician make the electrical connections.

**Putting in ductwork.** After cutting the hole in roof, wall, or eave, run the necessary ducting up to it and cover the opening with the appropriate outside cap (see sketch at right).

Finally, be sure that sufficient air can be drawn in under the door to replace the air you exhaust. If necessary, take the door down and trim up to a quarter-inch off the bottom rail. PS




**Here's how you wire fan** operated by its own switch. Multispeed switch can be substituted if desired.




**Wired to light fixture,** fan goes on when light does. In windowless rooms, this hookup must be used.



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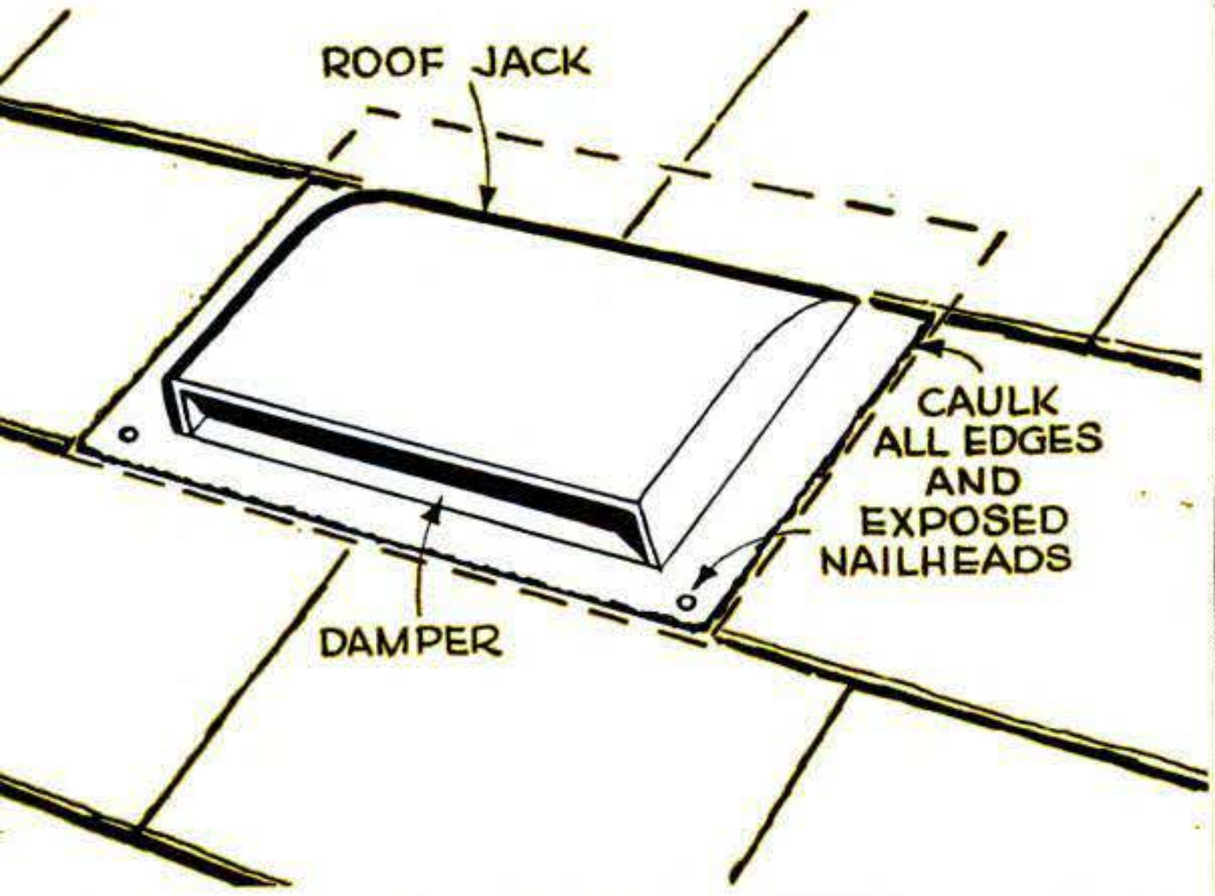
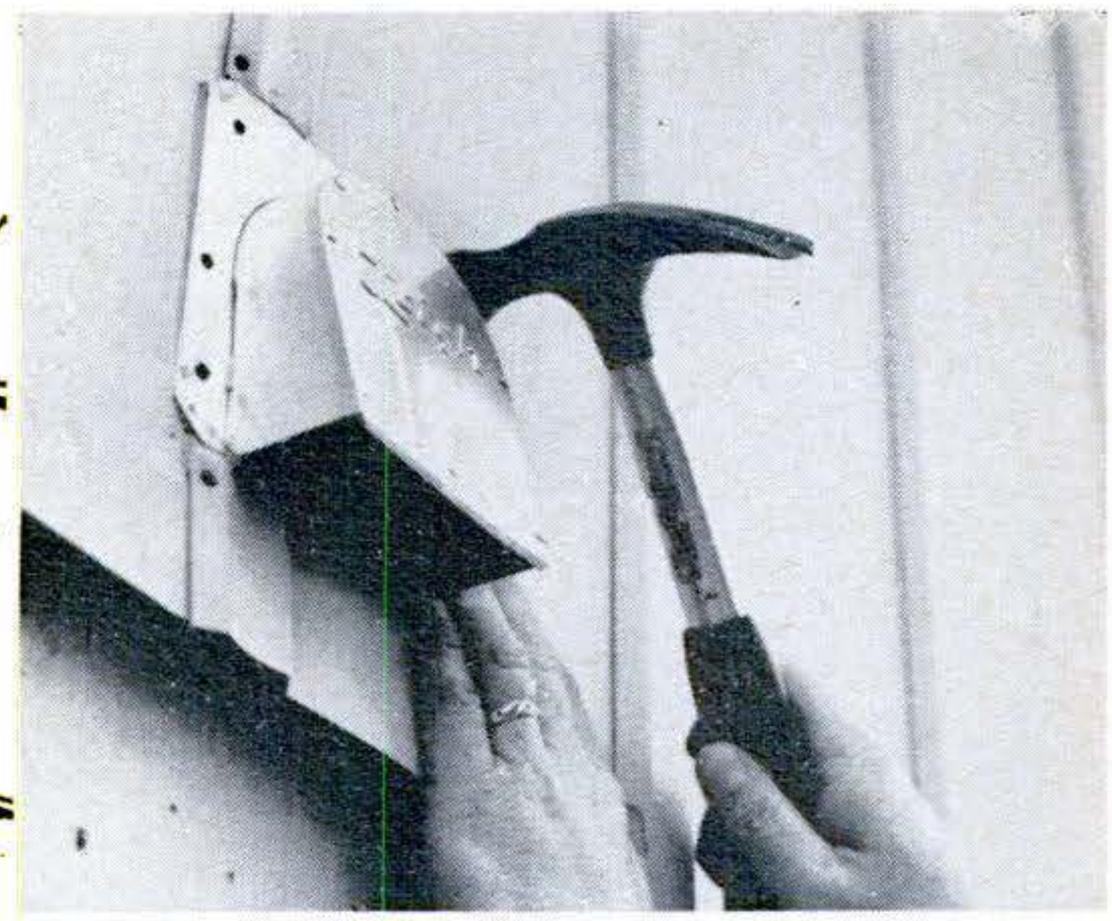
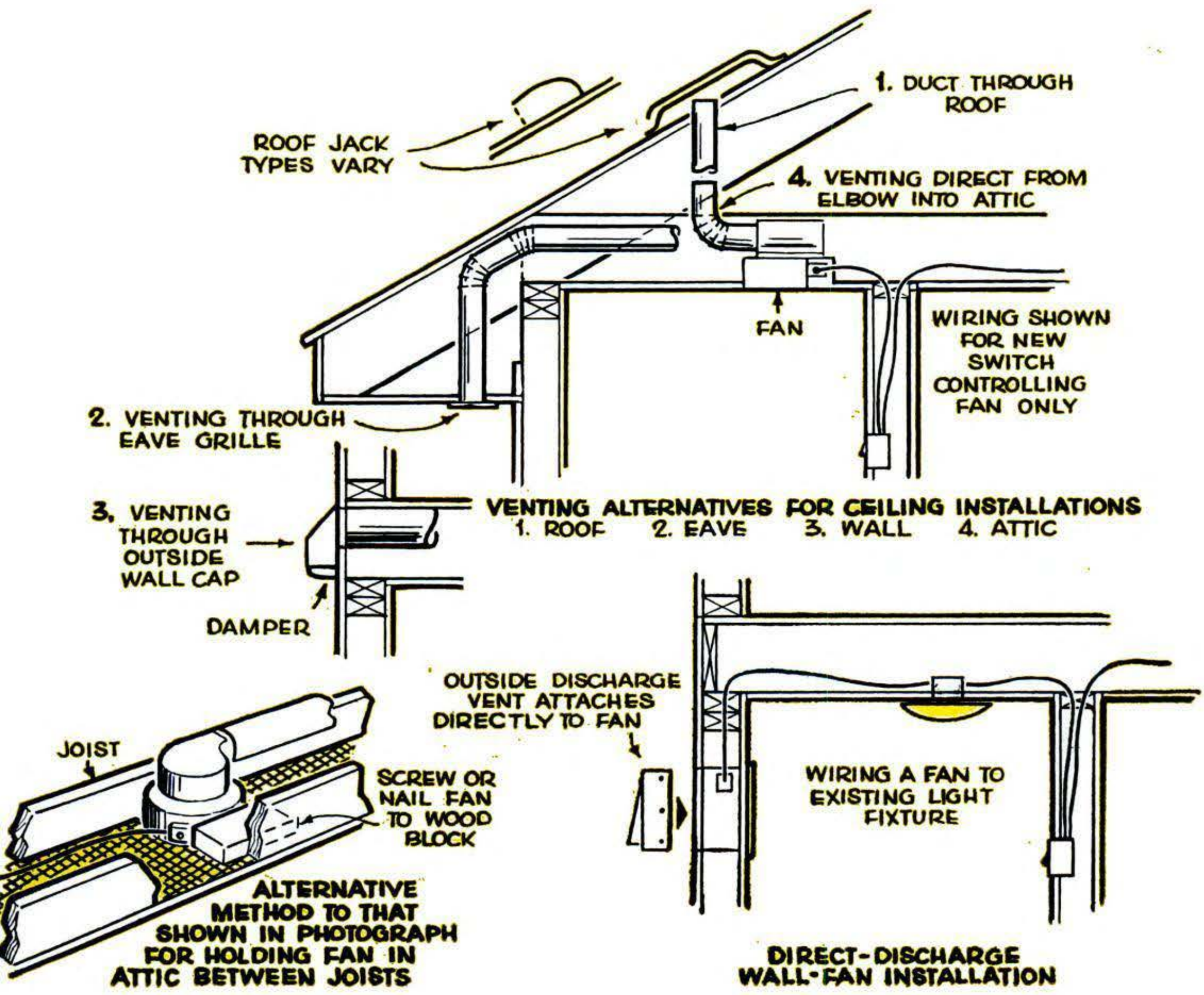



ter). Sketch shows leakproof placement with top of the flange under the upper course of shingles.



**Through-the-wall installation** is finished off with wall cap set in caulking and held with ring-type nails.



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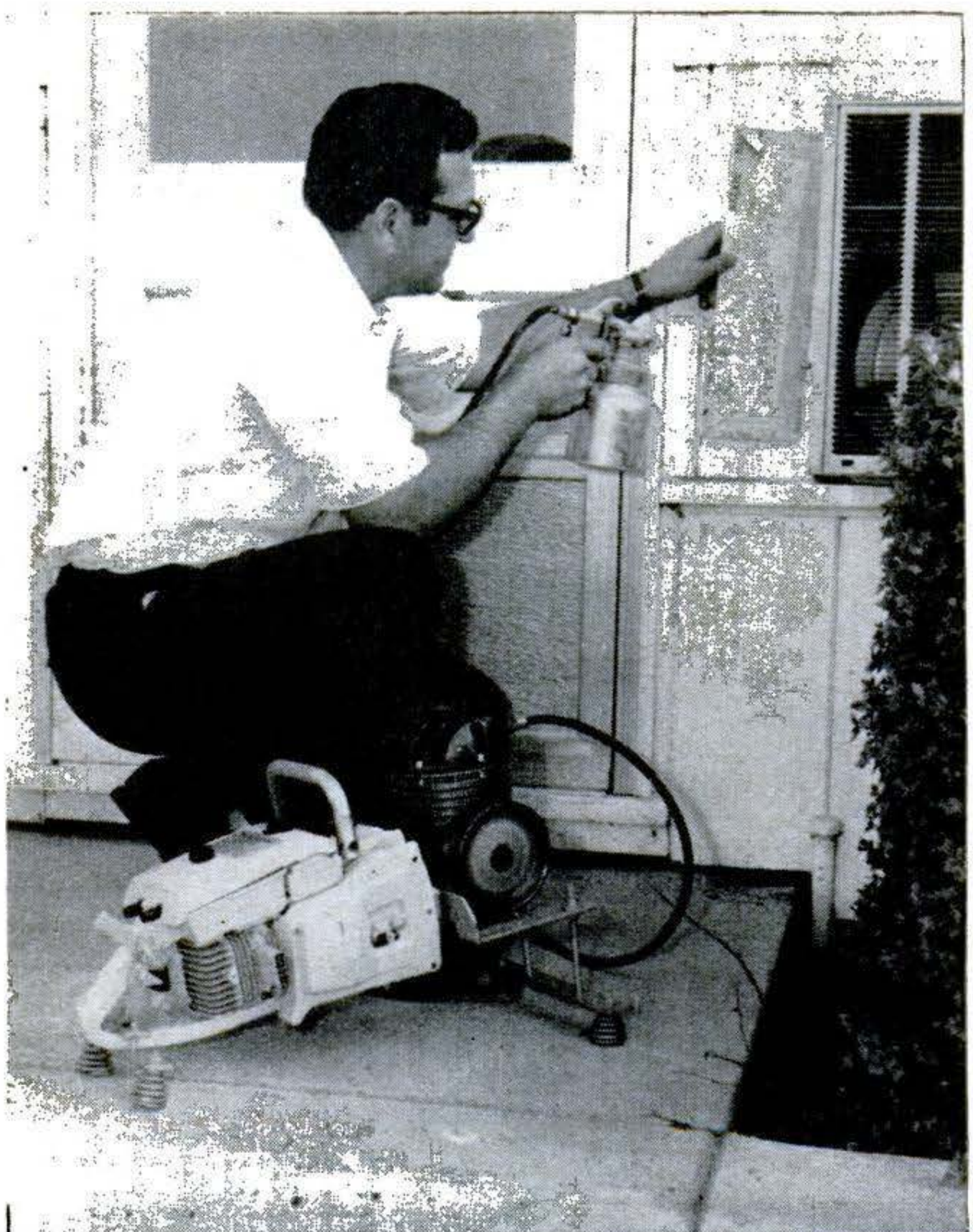
# Let Your

## New attachment gives you multi-use power where electricity is not readily available

By E. F. LINDSLEY
*PS Outdoor Power Equipment Editor*



**Saw-engine drive** makes touch-up jobs or all-day spray painting practical anywhere. Either a diaphragm or a piston-type compressor can be used.

**Abrasive cutoff saw** offers greater capacity than most equivalent electrics, slices through metal as fast. Same shaft drives drill chuck and flexible shaft.

**Direct-drive drilling** is possible with right-hand-start saws, such as this McCulloch model. Others require jackshaft adapter as shown in the photo at left.



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# Chain-Saw Engine Run the Works

Most chain-saw owners use their saws only occasionally. Recognizing this, the R. F. Kroll Co. (Wautoma, Wis. 54982) now offers a multi-use attachment package that adapts the saw engine to a pump, air compressor, cutoff blade for masonry or metal, or a drill. The attachment is especially good for use where electric power isn't available to run conventional electric tools.

In addition to putting the idle engine to work, the attachment offers these advantages:

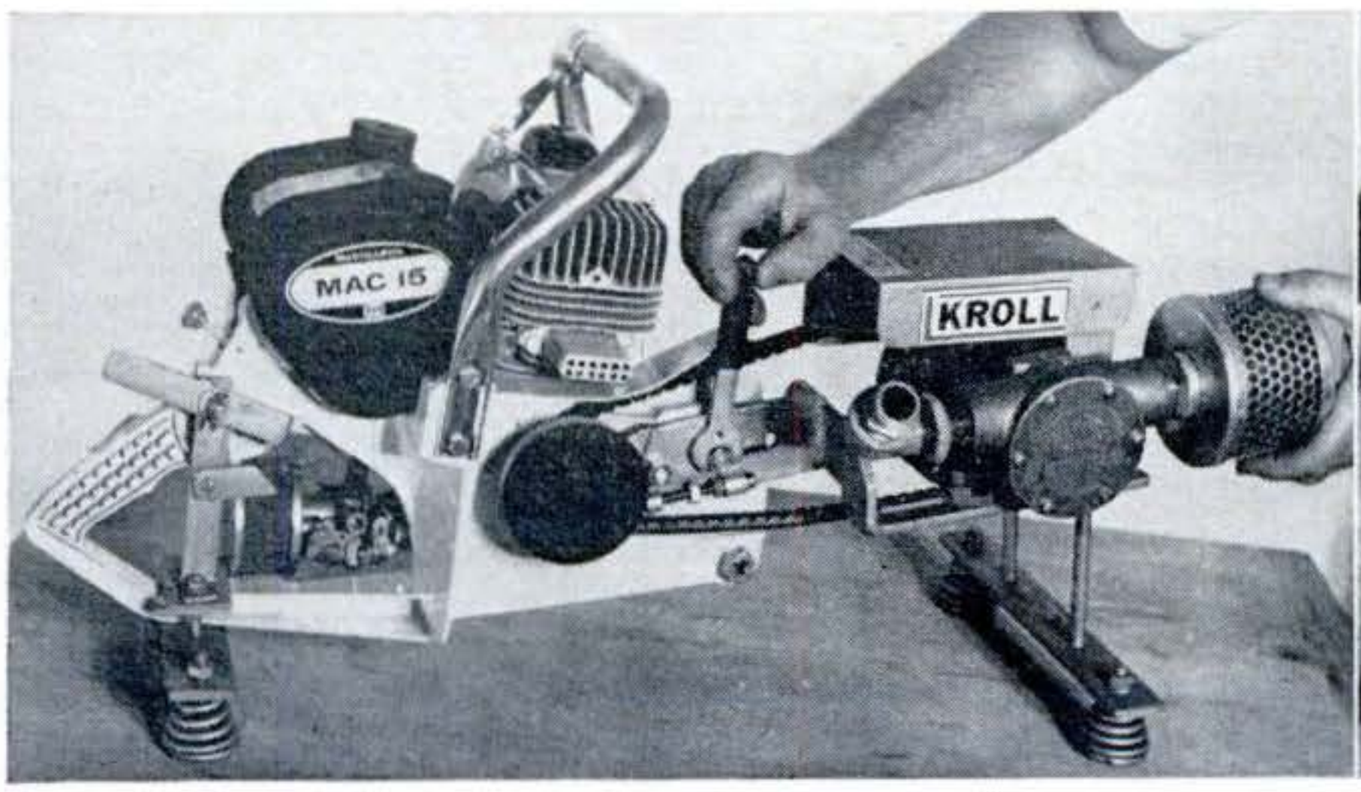
- High power (several horsepower).
- Light weight, with easy portability.
- Standard mount; it fits all saws.
- Smooth operation.
- Centrifugal clutch drops out at idle.
- Variable speed, suited to work.

You bolt the attachment to the saw in place of the blade bar and substitute a pulley for the chain sprocket—unless your saw has a pulley in place. The chain-tension adjustment is used to snug up the belt. An exception to belt drive is the direct-drive drill chuck (see photo on facing page).

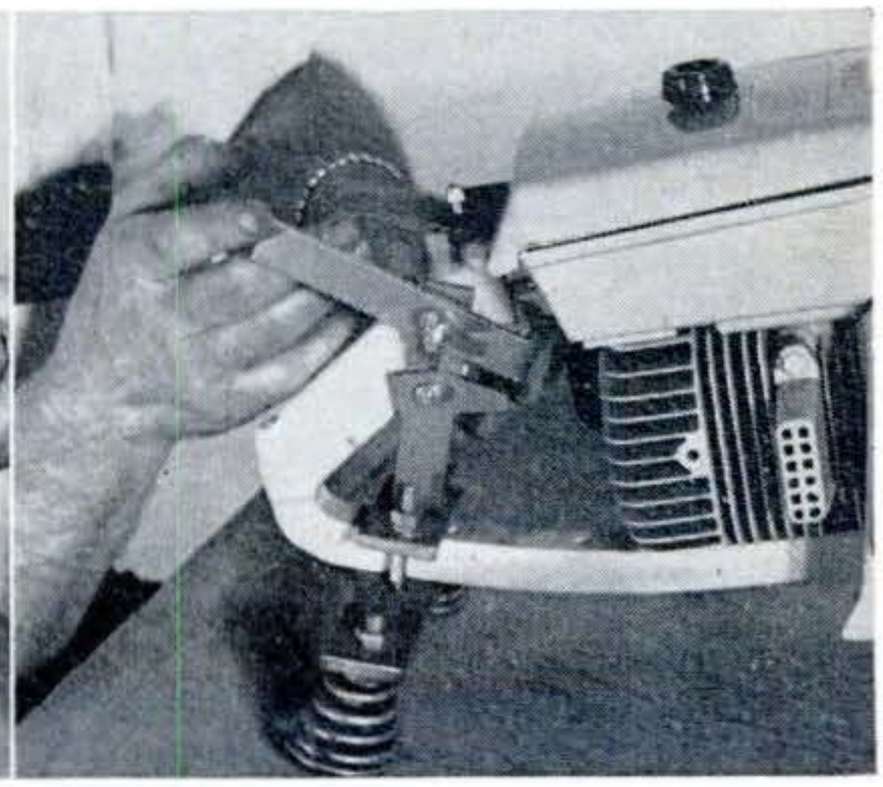
The cutoff saw has many uses in construction, rescue, and metal work, while the pump can be used for anything from irrigation to boat bailing or filling stock tanks. The compressor offers quick aid for flat tires, air for blasting parts clean in field repairs, or air for inflation or spraying.

Complete kits with pump or compressor are priced at approximately $90. The basic bracket attachment is about $26 for users who already have compressors or pumps. The kits, which are available now, are being marketed through McCulloch dealers.

**High pumping capacity,** lightness, and smooth running are features author liked. Pump output is 22 gallons per minute; water pressure is about 40 p.s.i.




**Basic attachments** mount on blade bar of the saw engine; bolt spacings are standard. Some chain saws have a pulley in place; others require replacement of chain sprocket with a pulley.



**Saw engine** runs about 1/3 speed for all tools except abrasive cutoff saw. Throttle control changes speed instantly.



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## It pays to know the big differences—

# Before You Buy

**BY E. F. LINDSLEY**
*PS Outdoor Power Equipment Editor*

Using a snow thrower can be fun. But buying one you'll be happy with takes a bit of savvy. There are three basic types:

- Superlight, hand-pushed, two-handled paddle-wheelers powered by two-cycle engines or electric motors. They can be used shovel fashion and hung up like a broom for storage.
- Conventional walk-behinds. Ranging from about four to seven hp., nearly all are self-propelled. The differences are in details, capacities, and features. Electrics are available.
- Riders. You must first buy a lawn or garden tractor and then add the snow thrower as an attachment. Here, the differences, in addition to power, will reflect the basic-tractor transmission plus the convenience (or lack of it) in connecting the thrower and drive.

**The lightweights.** Toro's 14-incher comes with both gasoline and electric power. AMF calls theirs a "powered snow shovel." Although all can be rolled along a sidewalk on miniature wheels, these pint-size paddle-wheelers also sprout two handles to permit shovel-fashion swinging. For flailing away a drift from the back steps, hacking a path to the bird feeder through frozen windrows, or rooting under a bottomed-down car, a lightweight can't be beat. Stowed in a car trunk, it's a real ace in the hole. Cost: around $100.

**The walk-behinds.** The really big selection in snow throwers comes in the four- to seven-hp. self-propelleds. At the top of the bracket you're investing $300 to $400. For this money you should get a lifetime of service. Hence, shop and buy brand names from long-established manufacturers with reputable retail and service outlets. Blacksmiths who can cobble up replacement parts for orphan snow throwers are hard to find.

There are some basic choices in the walk-behinds:

- Tractor-mounted or pure snow thrower. Some of the first throwers were front-mount attachments for powerful two-wheel walking tractors. Simplicity's

**Self-propelled walk-behind** such as this seven-hp. Gilson is one type of snow thrower you might buy.

**Powered snow shovels** are popular for light jobs. They come in both gas, below, and electric models.

# a SNOW THROWER

Model W with eight hp. is an example. These are still available and take blade or thrower. Such units are normally very heavy duty for either commercial or residential use.

• Convertible snow throwers with summer-use attachments available. Ariens has long offered this feature, although some owners may not be aware that the auger can be dropped free of the power unit and a mower attached. The Wheel Horse Trailblazer 7 is another example. It mounts a dandy 32-inch rotary deck after the thrower latches are released. The same deck can also be fitted to the Wheel Horse five-hp. thrower. Bolens has just entered this field with its Arctic 70. In the summer it will drive a front-mounted reel mower.

• Conventional, snow-thrower-only machines. Intended strictly for winter use, performance is no different than with the convertibles, although the latter do tend to be in the quality price and construction slot. Gilson and Allis-Chalmers, both top-line throwers, are single-purpose.

Old-time snow-thrower users talk knowingly of single-stage, two-stage, and even three-stage machines. This goes back to the early days of snow throwers when many throwers were lightweight, push-type and had a single impeller.

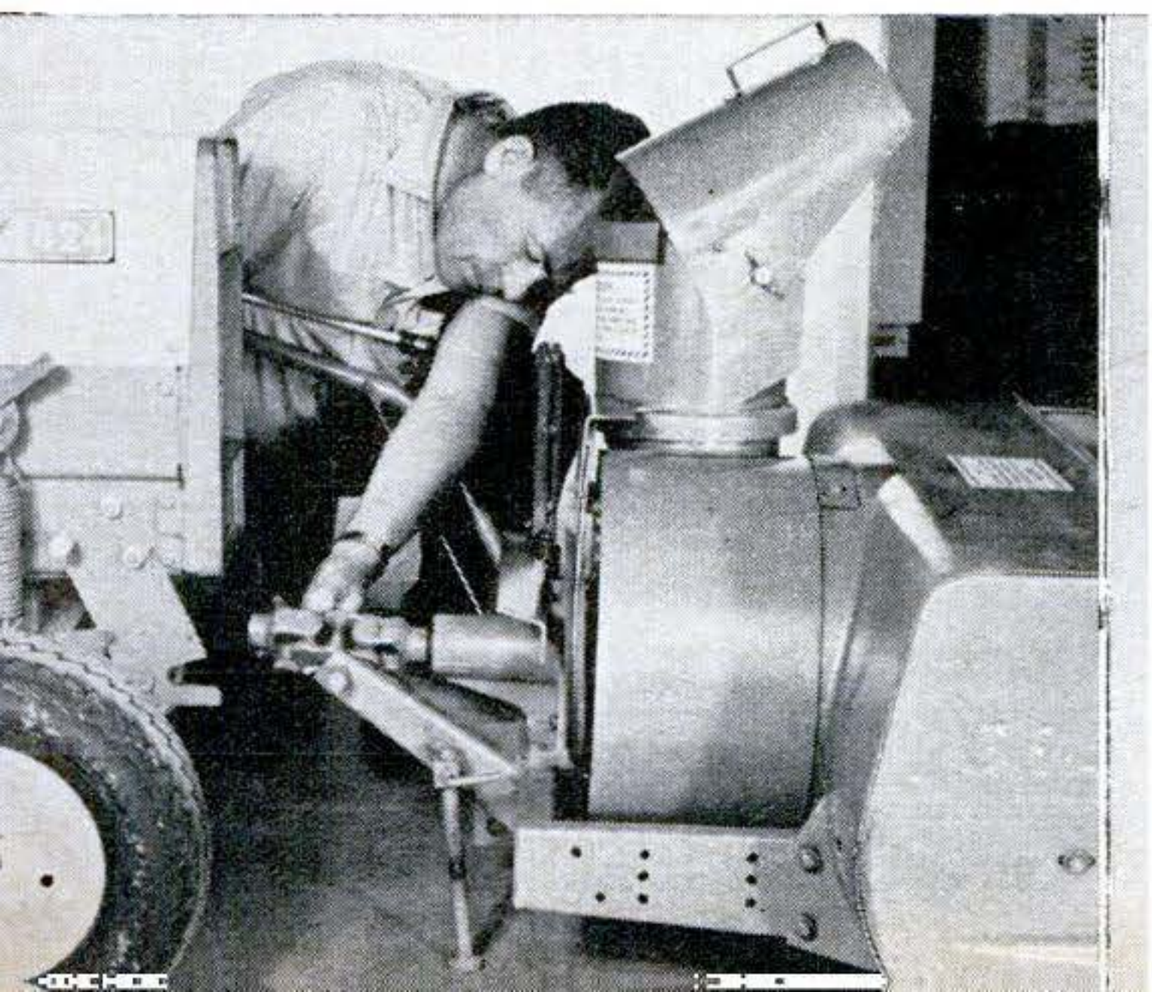
The impeller was a rotating disk with two- or four-paddle blades that pitched the snow out the discharge chute much like a centrifugal water pump. Some throwers are still made this way—such as the Sear's 18-inch self-propelled job. Later, with more powerful engines available and the demand for greater snow-removal capacity, makers added a front auger with spiral blades that rotate slowly in a position crosswise of the intake. The slow-turning auger, working at about 100 r.p.m., chops up the snow and feeds it back into an impeller turning at much higher speed. Thus, the original impeller became a second stage, since it handled the snow after the auger.

Wisconsin Marine does the job just a bit differently. Instead of a continuous auger, this company uses segments of auger blades for better penetration of hardened snow. A double-paddle-wheel second stage turns in the same plane as the auger. Other makers have found ways of making the auger do all the work, including throwing the snow out the chute, thus producing "single-stage" throwers.

Some throwers, notably Sears and AMF, have three stages, but this actually refers to a small auger or set of blades strung shish-kebab fashion above the main auger to break up the high drifts.

*Continued*

**Tractor-mounted throwers** handle about any job of snow removal encountered. Gravely 424 (left) puts 10 hp. to work through gear-and-shaft drive; 12-hp. Wheel Horse has hydraulic transmission.



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**How many stages are best?** Endless dispute can start here. In general, the trend seems to be towards two stages in the larger six- or seven-hp. sizes. On the other hand, Bolen's tractor attachments work just fine with a single stage. Also, many medium 20-inch machines with about four hp., like Toro's Snow Hound, are single-stage and they do a good job. Just to prove the point, Simplicity took

## A Selected List of the Newer Snow Throwers for 1968-69

| Maker or Seller | Model | Hp. | Auger Width (in.) | Self-Propelled? | Stages | Forward Speeds | Electric Start Available? | Engine Type | Blower and/or Auger Drive | Approx. Price | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Allis-Chalmers | SB 2524 | 5 | 24 | yes | 2 | 4 | yes | 4 cycle | chain | $330 | |
| | SB 2728 | 7 | 28 | yes | 2 | 4 | yes | 4 cycle | chain | 380 | |
| AMF | 1361 | 6 | 26 | yes | 3 | 4 | yes | 4 cycle | shaft | 374.95 | |
| | 1362 | 7 | 26 | yes | 3 | 4 | yes | 4 cycle | shaft | 389.95 | |
| | 1360 | 4 | 26 | yes | 2 | 4 | no | 4 cycle | shaft | 299.95 | |
| | 1365 | NA | 14 | no | 1 | — | no | 2 cycle | chain | 109.95 | Paddle type |
| Ariens | 22999 | 4 | 20 | yes | 2 | 4 | no | 4 cycle | shaft | 229.95 | Helical gears, all models; auger drv. differential kits available; converts for summer use |
| | 10965 | 5 | 24 | yes | 2 | 4 | yes | 4 cycle | shaft | 299.95 | |
| | 10970 | 6 | 24 | yes | 2 | 4 | yes | 4 cycle | shaft | 349.95 | |
| | 10957 | 7 | 32 | yes | 2 | 4 | yes | 4 cycle | shaft | 389.95 | |
| Atlas | SN420 | 4 | 20 | yes | 1 | 1 | no | 4 cycle | chain | 169.95 | |
| Bolens | Artic 70 | 7 | 26 | yes | 2 | 4 | yes | 4 cycle | shaft | 369.95 | Convertible |
| Gilson | 834 | 5 | 26 | yes | 2 | 1 | no | 4 cycle | shaft | 324.95 | |
| | 835 | 7 | 26 | yes | 2 | 2 | yes | 4 cycle | shaft | 374.95 | |
| | 832 | 5 | 22 | yes | 1 | 1 | no | 4 cycle | chain | 269.95 | |
| | 833 | 7 | 22 | yes | 1 | 1 | yes | 4 cycle | chain | 314.95 | |
| Hahn-Eclipse | CH588-7 | 7 | 28 | yes | 2 | 4 | yes | 4 cycle | chain | 379.95 | |
| | CH584-6 | 6 | 24 | yes | 2 | 4 | yes | 4 cycle | chain | 389.95 | |
| | CH584-5 | 5 | 24 | yes | 2 | 4 | yes | 4 cycle | chain | 349.95 | |
| | CH520-4 | 4 | 20 | yes | 1 | 1 | no | 4 cycle | chain | 199.95 | No reverse |
| Jacobsen | Sno-Blitz | 2 | 17 | no | 1 | — | no | 2 cycle | chain | 99.95 | 26 lb. superlight |
| | Sno-Jet | 3½ | 20 | yes | 1 | 1 | no | 4 cycle | chain | 229.95 | Safety chute guard |
| | Imperial | 6 | 26 | yes | 2 | 4 | no | 4 cycle | shaft | 359.95 | Safety chute guard |
| Lambert | HS-54-1 | 5 | 24 | yes | 2 | 2 | yes | 4 cycle | chain | 319.95 | |
| | HS-64F1 | 6 | 24 | yes | 2 | 2 | yes | 4 cycle | chain | 364.95 | Elec. start, all except SS-4, $59.95 extra |
| | HS-78-1 | 7 | 28 | yes | 2 | 2 | yes | 4 cycle | chain | 419.95 | |
| | SS-4 | 4 | 20 | yes | 1 | 1 | no | 4 cycle | chain | 199.95 | |
| | SS-5 | 5 | 24 | yes | 1 | 1 | yes | 4 cycle | chain | 280 | |
| MTD Prod. | 318-300 | 4 | 21 | yes | 1 | 1 | no | 4 cycle | shaft | 224.95 | |
| | 318-400 | 5 | 21 | yes | 1 | 1 | no | 4 cycle | shaft | 259.95 | |
| | 318-500 | 5 | 21 | yes | 1 | 1 | yes | 4 cycle | shaft | 319.95 | |
| | 318-600 | 5 | 26 | yes | 2 | 5 (var.) | no | 4 cycle | shaft | 309.95 | Variable-speed trans. on 3 models |
| | 318-700 | 7 | 26 | yes | 2 | 5 (var.) | no | 4 cycle | shaft | 339.95 | |
| | 318-800 | 7 | 26 | yes | 2 | 5 (var.) | yes | 4 cycle | shaft | 399.95 | |
| Sears | 82562 | 6 | 26 | yes | 3 | 4 | yes | 4 cycle | shaft | 410 | Alternator, lights |
| | 82552 | 6 | 24 | yes | 1 | 2 | yes | 4 cycle | chain | 309 | |
| | 81929 | 3½ | 20 | yes | 1 | 1 | no | 4 cycle | chain | 189.95 | |
| | 82542 | 3½ | 18 | yes | 1 | 1 | no | 4 cycle | shaft | 208.95 | |
| Simplicity | 428 | 6 | 26 | yes | 1 | 2 | yes | 4 cycle | chain | 324 | |
| | 430 | 7 | 26 | yes | 2 | 2 | yes | 4 cycle | shaft | 478 | Cont. traction diff. |
| Toro | Snow Pup 14 | 2½ | 14 | no | 1 | — | no | 2 cycle | chain | 99.95 | 22-lb. paddle whl. |
| | Snow Pup 21 | 3 | 21 | no | 1 | — | no | 2 cycle | chain | 119.95 | 22-lb. paddle whl. |
| | Snow Hound 20 | 3½ | 20 | yes | 1 | 1 | no | 4 cycle | chain | 189.95 | |
| Wards | 481 | 3 | 18 | no | 1 | — | no | 4 cycle | chain | 119 | |
| | 484 | 4 | 22 | yes | 1 | 1 | no | 4 cycle | shaft | 229.95 | Reverse |
| | 489 | 5 | 22 | yes | 2 | 1 | no | 4 cycle | shaft | 299 | Reverse |
| | 477 | 7 | 26 | yes | 2 | 2 | no | 4 cycle | shaft | 359 | |
| | 478 | 7 | 26 | yes | 2 | 2 | yes | 4 cycle | shaft | 419 | |
| Wheel Horse | Trailblazer 5 | 5 | 26 | yes | 2 | 2 | yes | 4 cycle | shaft | 299 | Full ball bearing; takes 32" mower |
| | Trailblazer 7 | 7 | 26 | yes | 2 | 2 | yes | 4 clcle | shaft | 359 | |
| Wis. Marine | Bob-Cat 820 | 5 | 20 | yes | 2 | 1 | no | 4 cycle | chain | 299.50 | Geared engine drive to splined shaft (820) |
| | Bob-Cat 1824 | 7 | 24 | yes | 2 | 1 | yes | 4 cycle | chain | 367.50 | |
| Yardman | 7000 | 4 | 22 | yes | 2 | 1 | no | 4 cycle | chain | 249.95 | No reverse |
| | 7040 | 5 | 22 | yes | 2 | 1 | yes | 4 cycle | chain | 289.95 | |
| | 7010 | 6 | 24 | yes | 2 | 1 | yes | 4 cycle | chain | 329.95 | |
| | 7020 | 7 | 26 | yes | 2 | 2 | yes | 4 cycle | chain | 389.95 | |
| **ELECTRICS** | | | | | | | | | | | |
| Jacobsen | Sno-Blitz | 2 | 17 | no | (two-handle, wheel or shovel) | | | | chain | $119.95 | |
| Sunbeam | LD16 | NA | 16 | no | 1 | | | | chain | 79.88 | |
| | DSA | NA | 16 | no | 1 | | | | chain | 99.95 | |
| | CD18 | NA | 18 | no | 1 | | | | chain | 149.95 | |
| | ST200 | NA | 18 | no | 1 | | | | chain | 169.95 | Headlight |
| | ST050 | NA | 16 | no | 1 | | | | chain | 119.88 | |
| Toro | Snow Pup Electric | 2½ | 14 | no | 1 (two-handle, wheel or shovel) | | | | chain | 119.95 | |

NA: Information not available

 **Clip and save this chart for use when you buy**

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pictures of their six-hp. single-stager operating in shallow water along a lake shore and throwing a fire-pump column of water out the chute. The seven-hp. Simplicity model is two-stage. Take your choice.

No single aspect of snow-thrower design is more important than the wheel drive, clutches, and controls. If you're equally satisfied with two or more competitive throwers, take a hard look at the controls, their versatility, and the convenience of their location. The manufacturer may have placed a control in a certain spot, or even omitted it, but you're the one who will be trying to find the lever with snow in your eyes on a dark night.

**How many speeds?** The number of forward speeds available reflects the type of transmission. Some throwers allow you to select from four speeds forward. This is extremely handy in matching snow conditions as well as your own state of energy and physical condition. Four speeds are available on Ariens, AMF, Sears, Allis-Chalmers, Jacobsen, Hahn-Eclipse, and probably others.

Mechanically minded readers will probably guess the problems of providing a four-speed *gear*box on a snow thrower and they'll be guessing right. No one does it with gears in this type of machine. The four speeds are obtained by a disk drive, with the rim of a friction disk running against the face of another. Shifting consists of moving the point of rim contact closer to or farther from the center axis of the drive disk. To reverse, the driven disk crosses over center. It's

**Dozer blade** is another way of removing snow if you own a riding vehicle like Bolens Estate Keeper. Many buyers prefer equipment they can use year round.

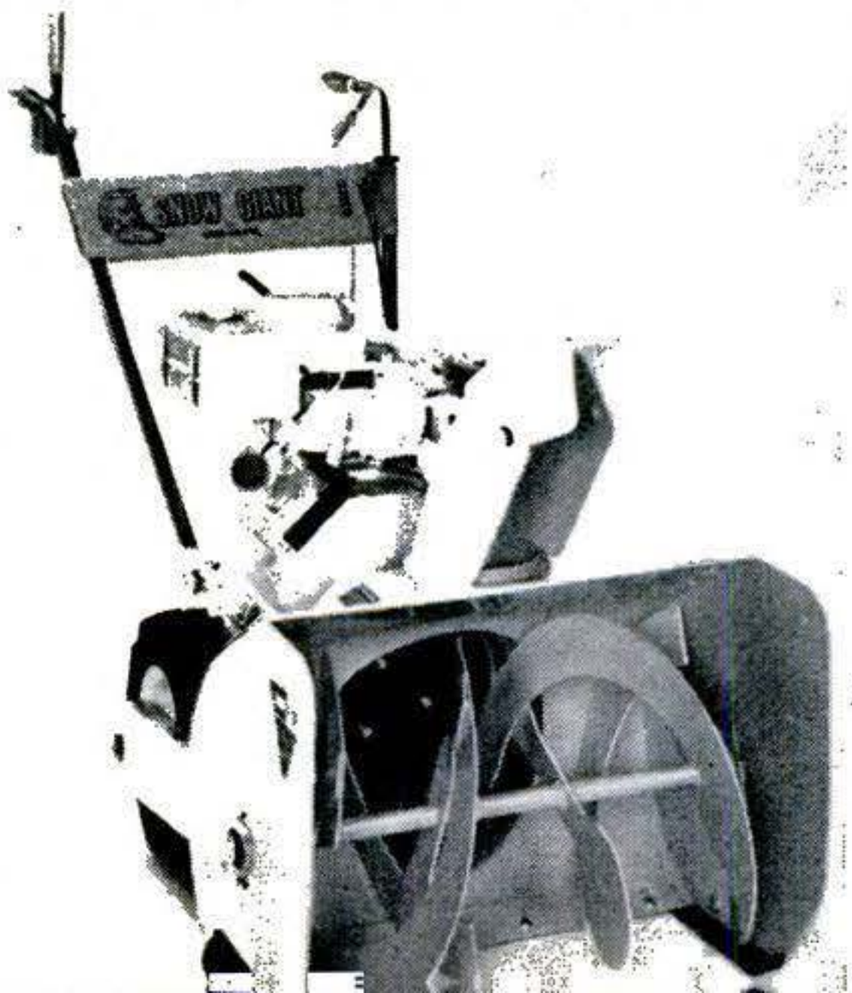
rugged, clashless, inexpensively repaired.

Other makers feel the merits of a solid gearbox justify some lack of speed selection and such machines are usually two-speed—high and low. Also, the change is normally made by engaging a range-change lever which may not be mounted on the handle. Sometimes, if the handle has a manual throttle control, a combination of engine-speed adjustment and gear range is mounted down on the engine or blower structure. The user is somewhat limited in his immediate options of power and speed.

In addition to transmission speeds and throttle location, take stock of the clutches. Commonly, there will be two, for auger and for wheels. At least one

[Continued on page 204]

**Typical walk-behinds** are pictured below—Simplicity's Sno-Away (left), Hahn-Eclipse Snow Giant (center), and Allis-Chalmers Sno-Bee. For other good ones of the same type, see the chart listing on facing page.



# TAKE YOUR CHOICE:

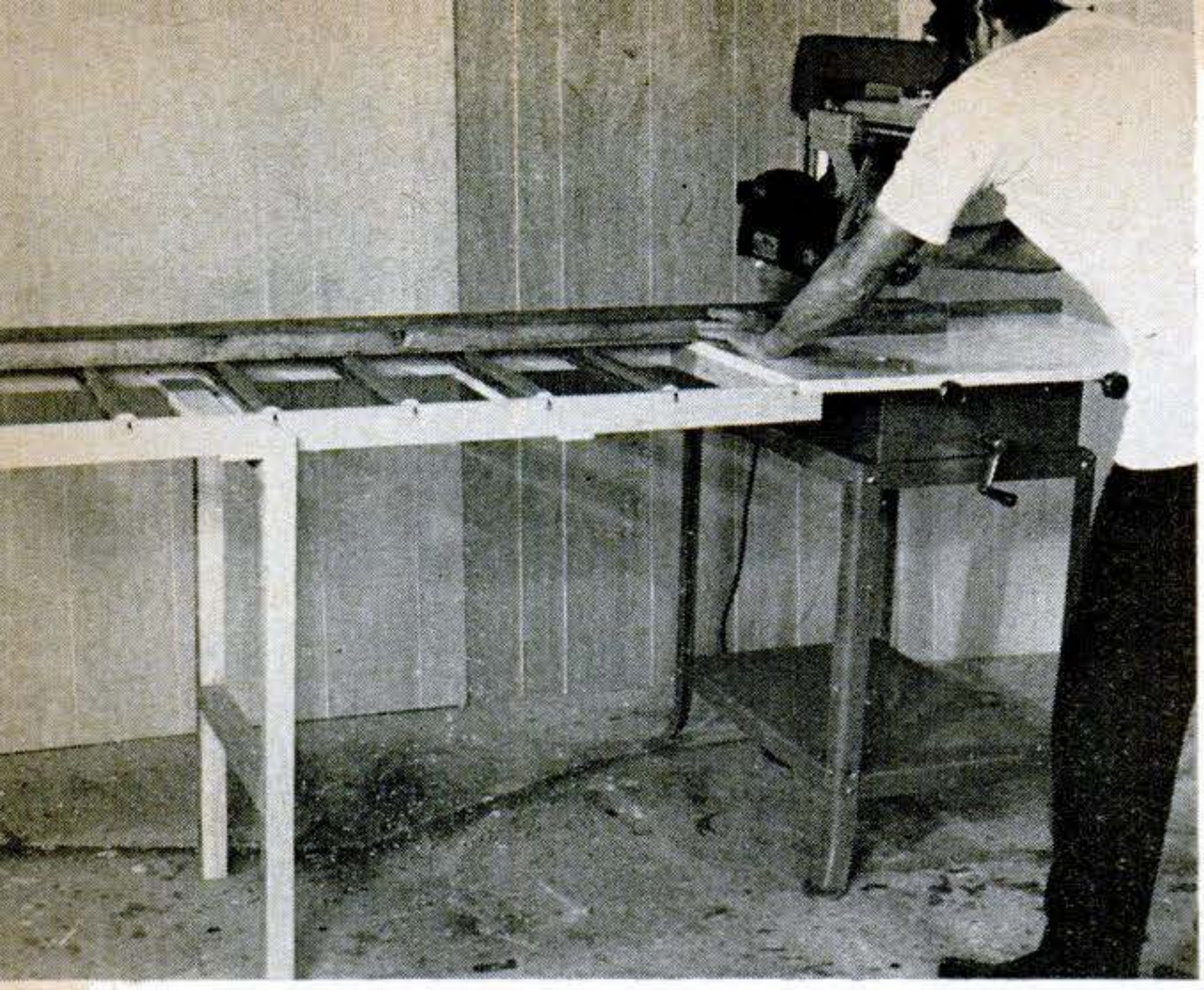
# Two Designs

By R. J. De CRISTOFORO

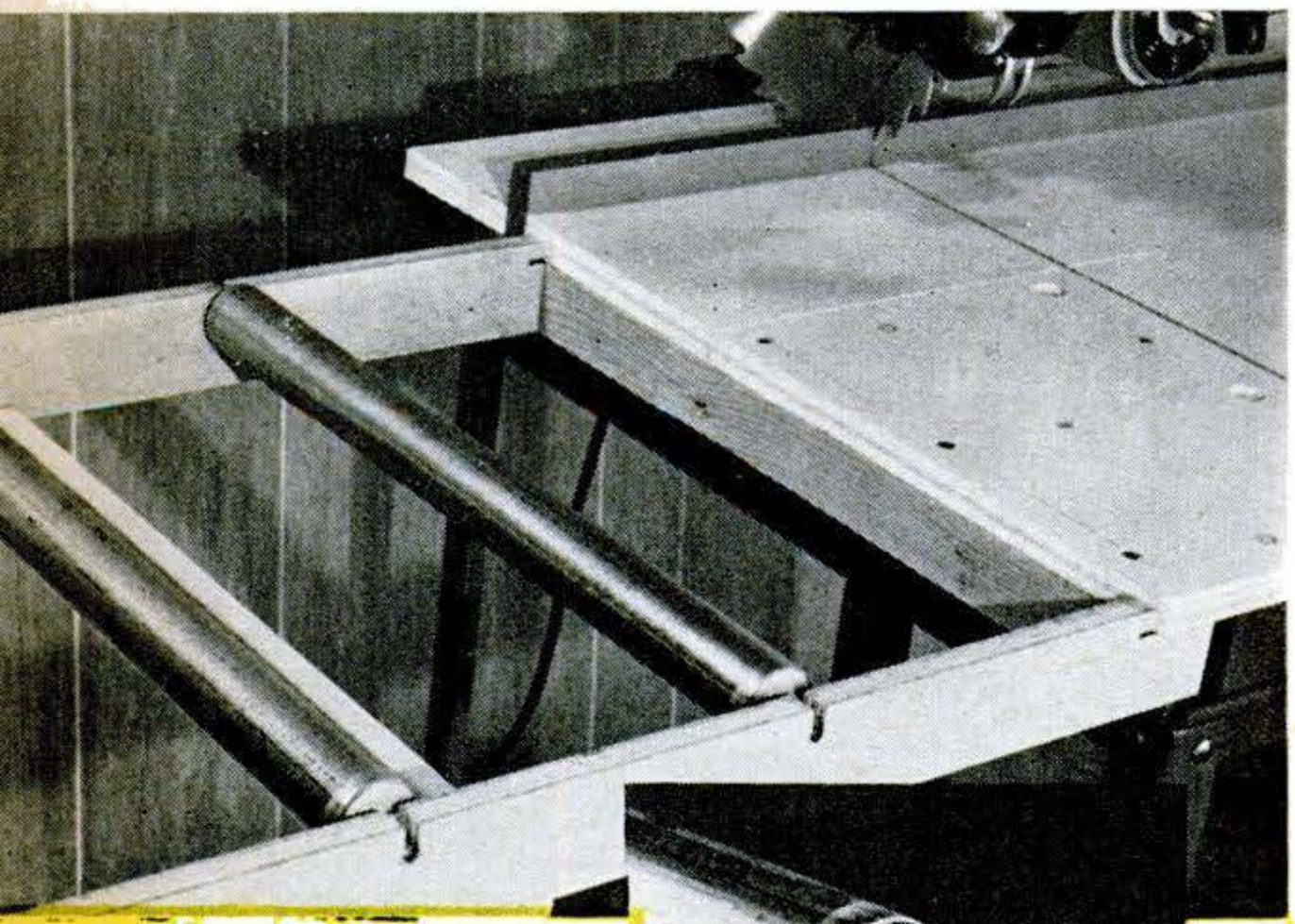
One of the great advantages of a radial-arm saw is the ease with which you can make cuts on long pieces of material. But this feature is like a seed: You must nurture it to make it wholly operational. You must provide a long enough platform for work support.

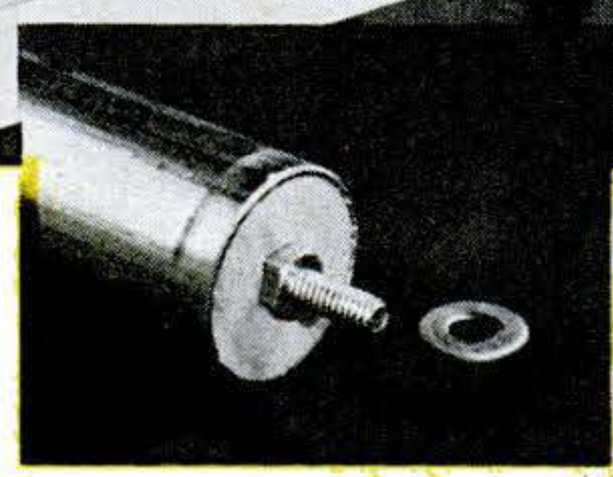
Contractors, who use machines outdoors and have no space limitations, do this by adding roller-type extensions. It's then no chore to square off the end of two-by stock 20′ or more long. Though this example may seem extreme, the fact is that you need a similar setup on your radial-arm saw even if the lengths you ordinarily work with are 8′ or less.

Two solutions are offered here. Both extensions are permanently attached to the

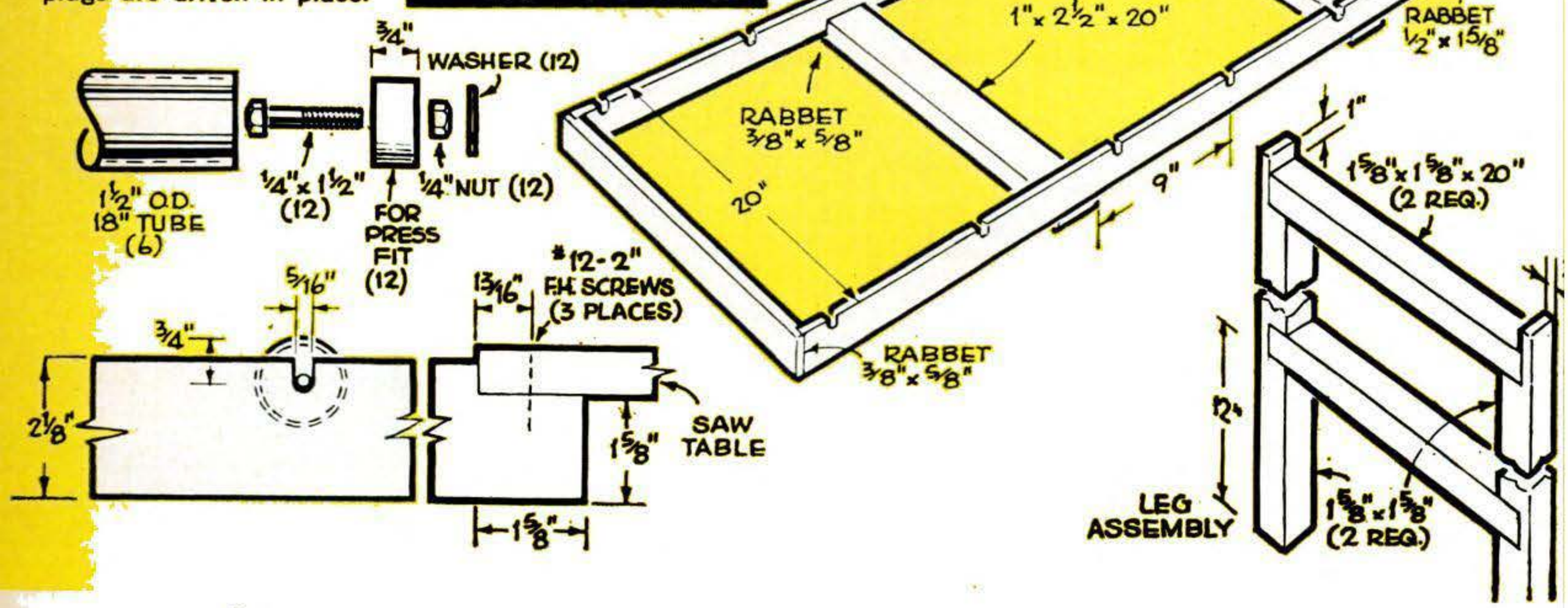


**Roller version,** based on a conventional design, uses materials that are readily available. With additional leg assemblies, you can make it longer.





**Wood plugs in ends of roller are cut for tight press fit; pivot bolts are installed (inset) before plugs are driven in place.**



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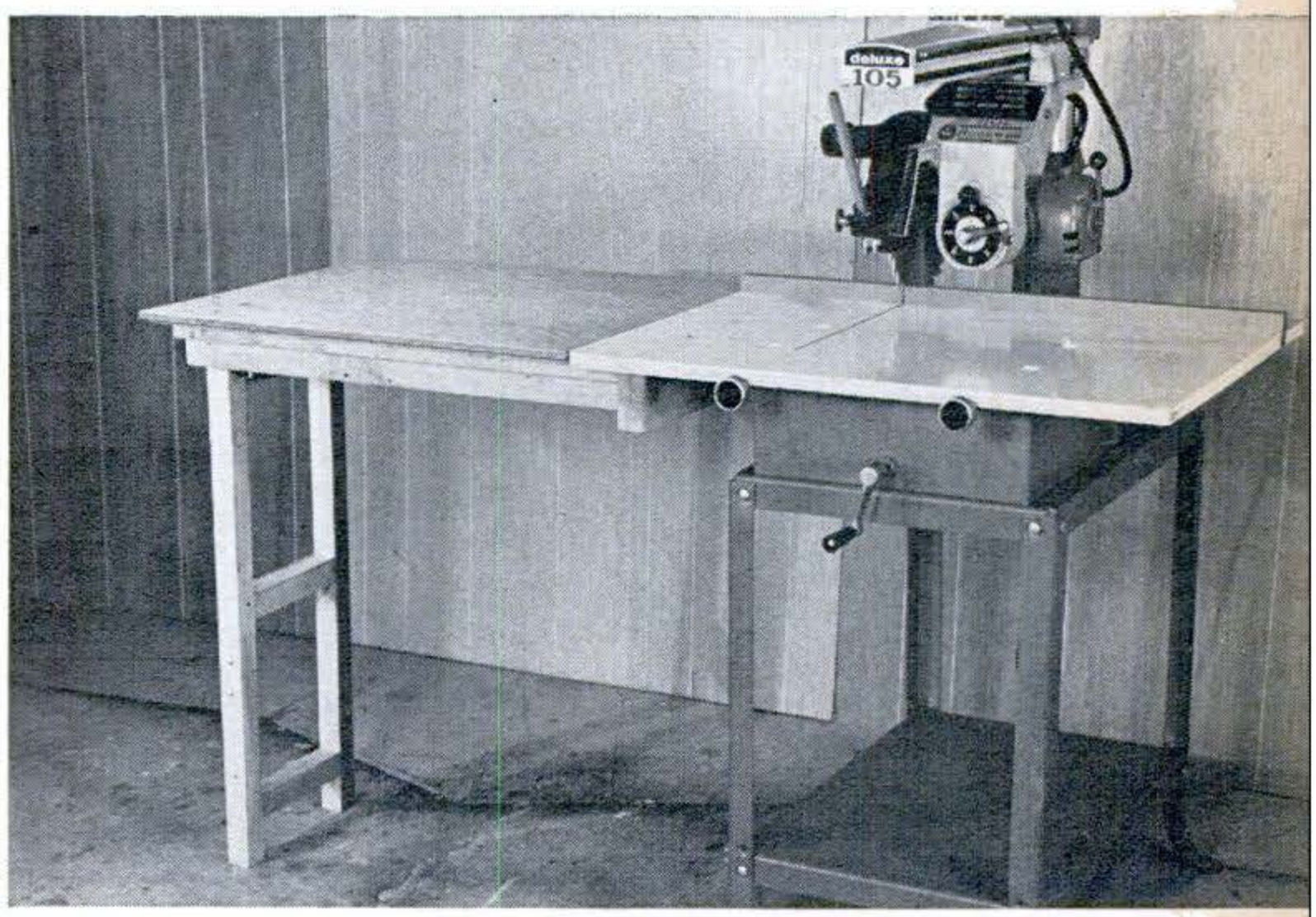
# for Saw-Table Extensions

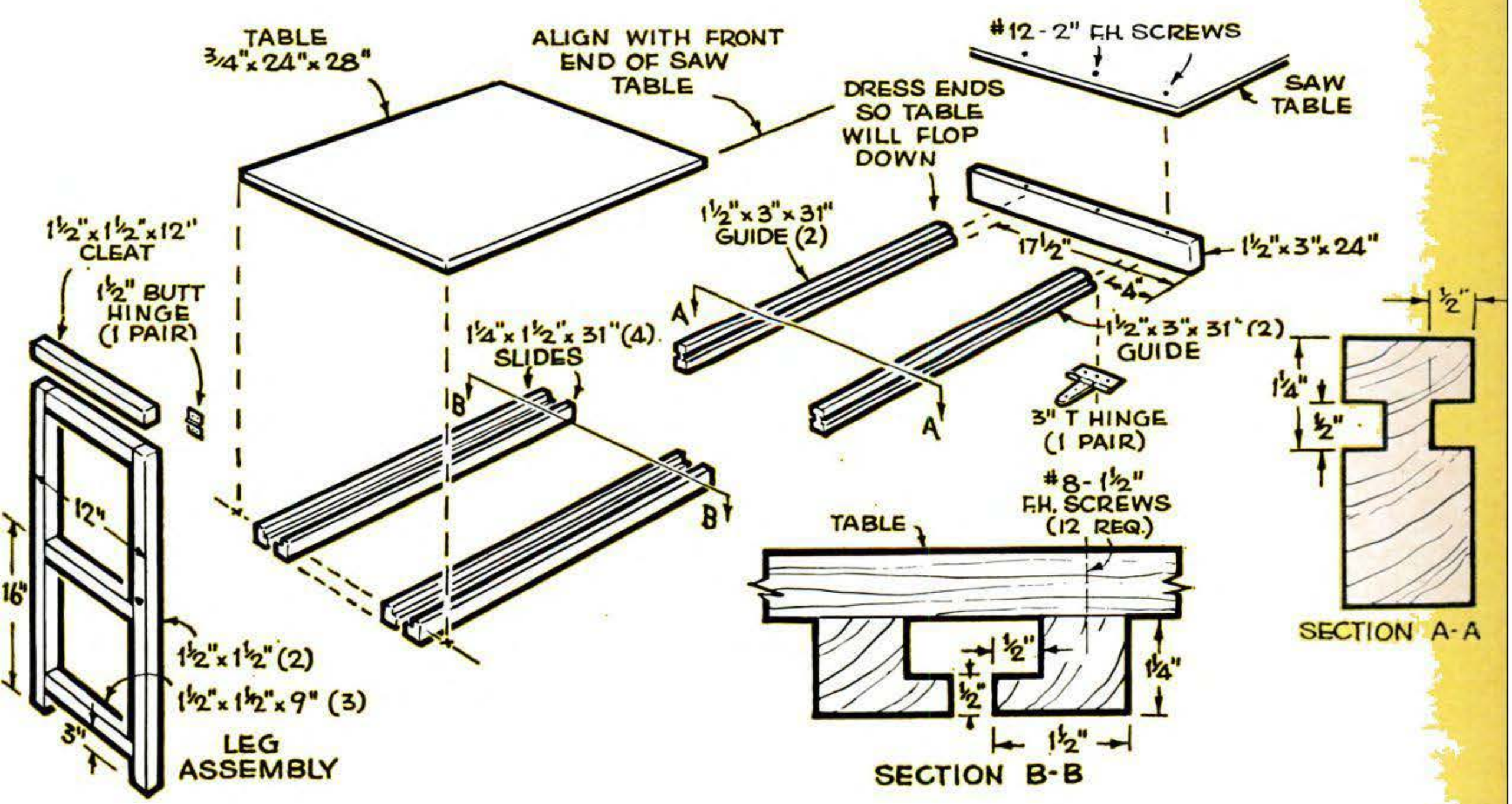
saw, but the roller extension can be knocked down by removing a few screws, and the hinged extension flips down when not in use, taking little more room than the saw itself. This version won't interfere with mobility if you have the tool on casters.

**Building the roller type.** Though the drawing gives specific dimensions, you can change them to suit. Two of these units, attached at either side of a 3′ saw table, will give you over 11′ of work support. You can make the extensions longer by providing more leg assemblies. If you work regularly with heavy structural lumber, you may prefer a stronger frame—substitute two-by-fours for the ⅝″ side pieces used.

*Continued*




**Fip-down version** extends the work surface about 2½′. Sliding action (see drawing below) nearly doubles support length. Table folds against stand.



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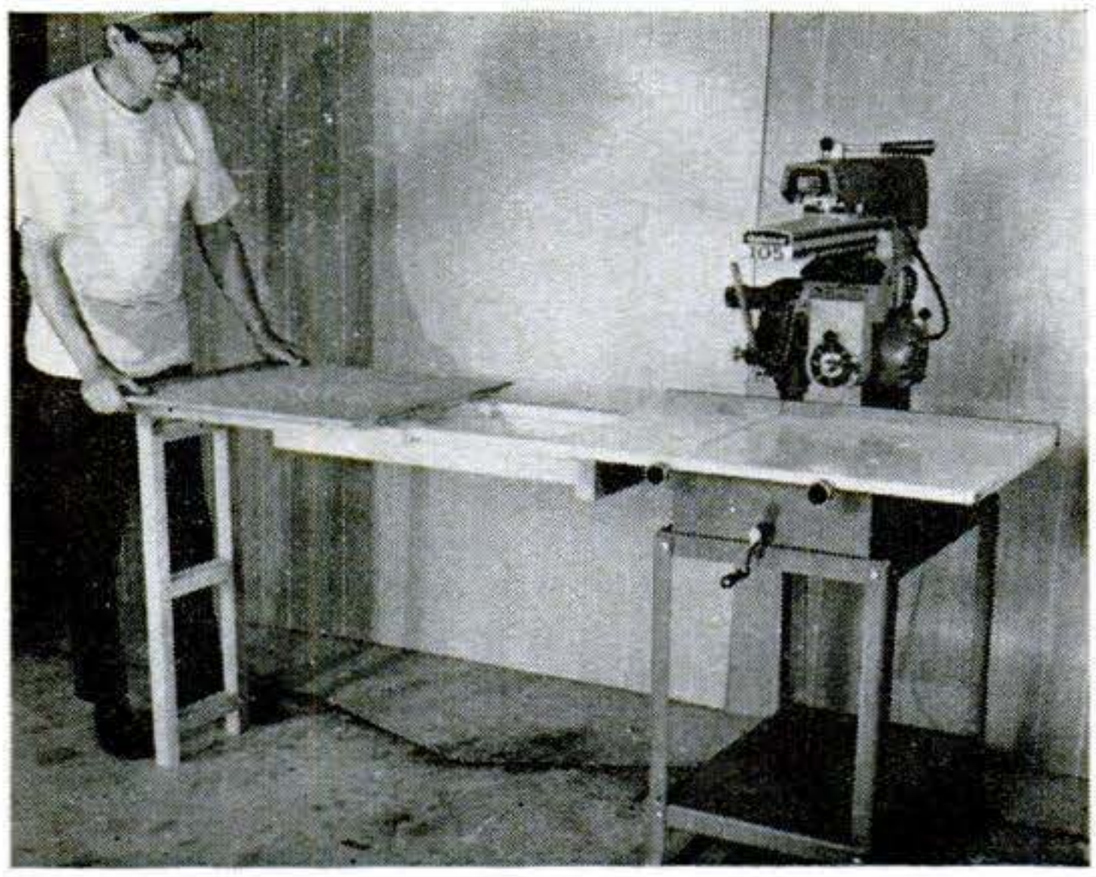
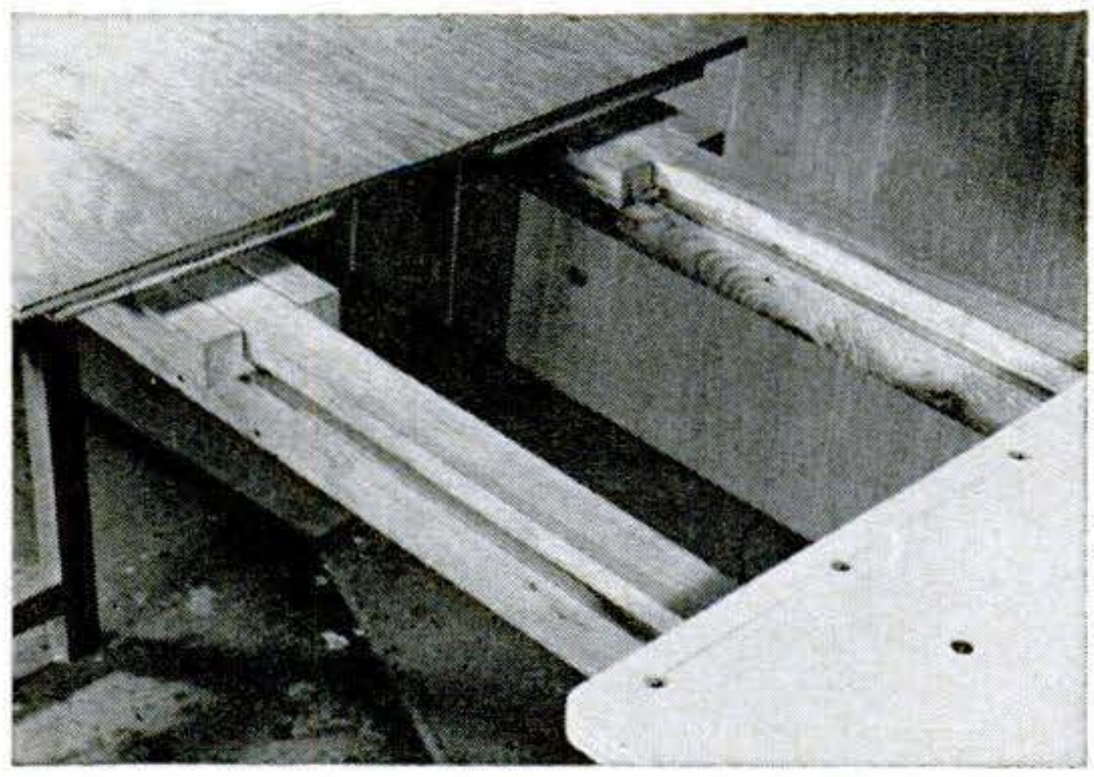
Material for the rollers can be any rigid tubing or pipe. There is no lack of suitable material, ranging from antenna masts to seamless tubes. The idea is to get something inexpensive with a good wall, of at least 1½" outside diameter. I settled for a 10' length of clothesline mast, costing about $3. To get square ends when cutting, I scribed a mark with a tube cutter, cut with a hacksaw, and touched up sharp edges with a disk sander and file.



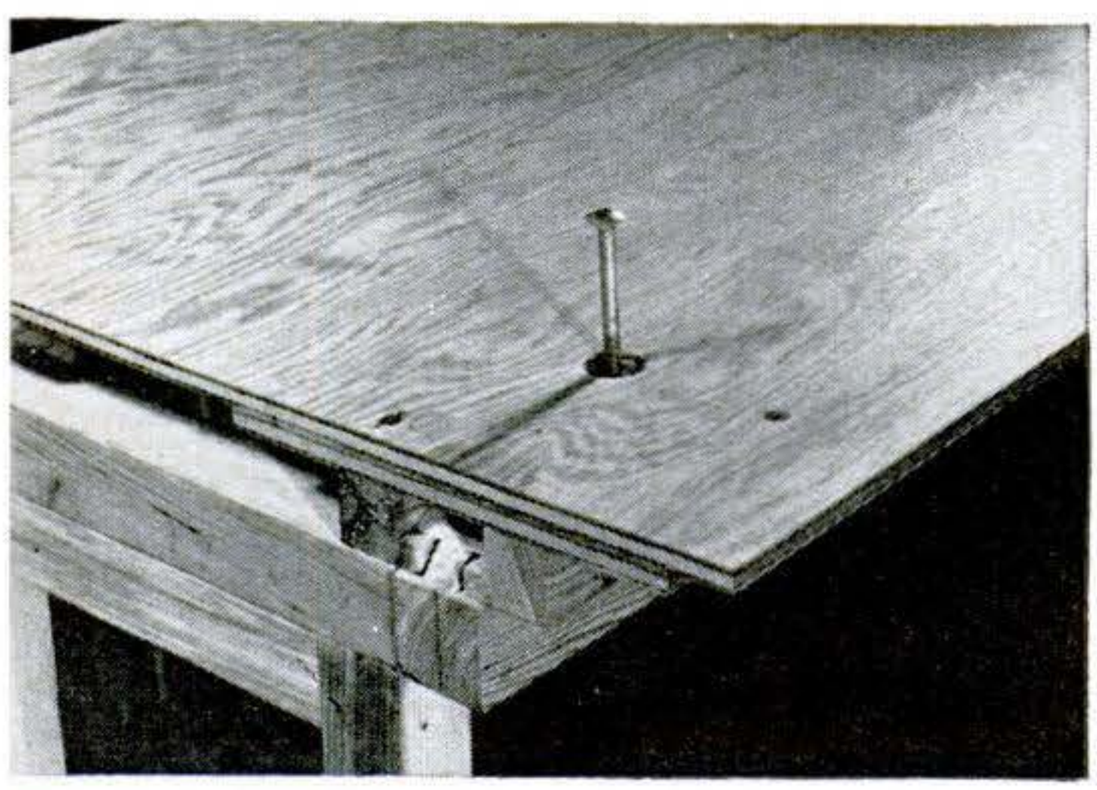
**Extension with a built-in extension** lets you handle long boards with minimum effort. Yet table telescopes to store out of the way when not needed.

**The wood plugs.** Cut the ¾"-thick plugs with an adjustable hole saw if you have one available. The tight press-fit you'll get with such plugs is ideal since it's all you need to keep the plugs in place—and the hole saw, with a ¼" pilot drill, also provides an accurate center hole. Seating the plugs will be easier if you chamfer one end first, and then make a drive block by drilling a ½" hole through a piece of scrap hardwood. If you lack a hole saw, cut plugs as accurately as possible and, after inserting them, drill several small holes through the tubing and lock each plug in place by driving brads into its edge. The bolt axles, of course, are secured before the plugs are inserted.

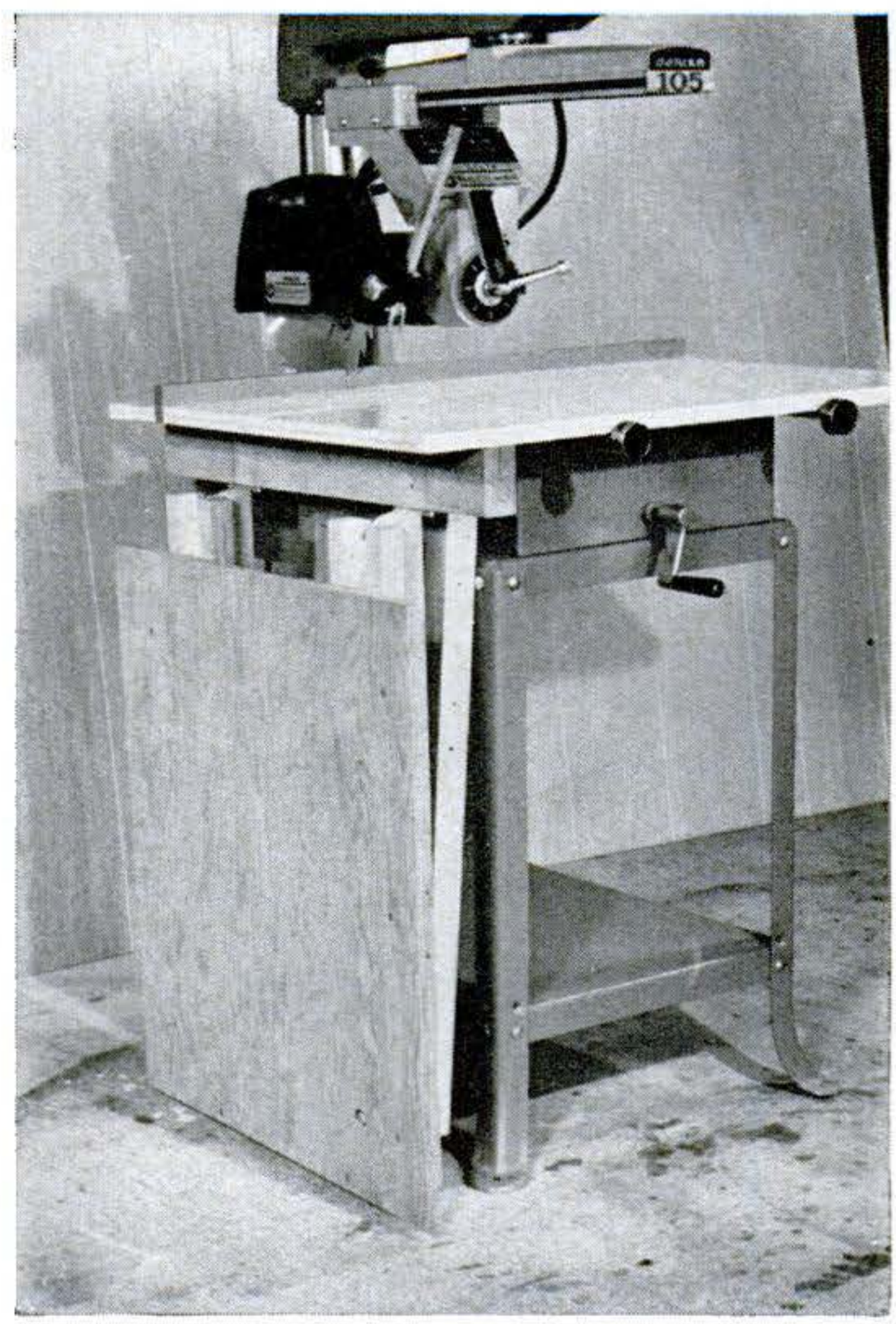
[Continued on page 198]



**Guide-slide assembly** should be positioned accurately, dressed for loose fit so table moves easily. This one is built-up ⅜" ply; ¾" would be better.



**This ¼" bolt is a lock** to keep table from sliding off when in storage position. Use a bolt long enough to be tapped up from the bottom for removal.



**In storage position,** extension table rests within floor space required by tool alone. Saw make and pedestal determine attachment-block location.



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SHORT CUTS AND TIPS

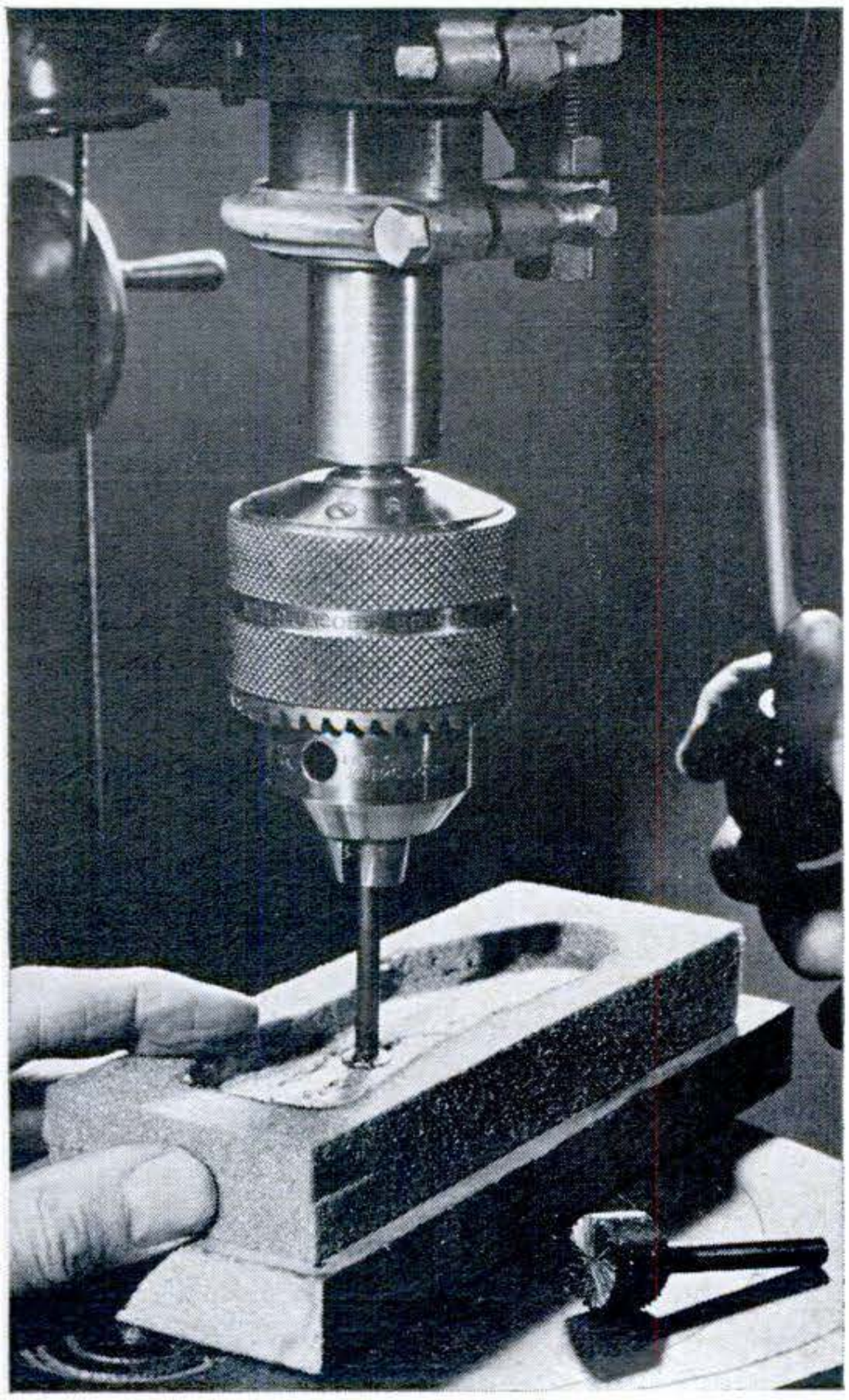
FROM HERE AND THERE

## Custom-made protection for delicate instruments

Here's a fine way to protect a precision tool in a carrying case: Encase it in a block of rigid plastic. Form the tool recesses with a rotary file or small milling cutter mounted in a drill press. Run the press at moderate speed while moving the block under the cutter to form the cavity (outlined first with a felt-tip pen).

Indentations, to match irregularities of the object, can be made with a small cutter, or by using the drill press as an arbor press. With press spindle not running, grip a large nail, head down (below, left), in the chuck, indent foam with direct downward pressure. Smooth the cavity with abrasive cloth. For easy removal of the tool, form finger holes by making a few deeper indentations.

WALTER E. BURTON, Akron, Ohio.



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# GROWING HOBBY:

# Load Your Own Ammo

**A wide choice of supplies now lets you customize better cartridges and shells than you can buy**

By PAUL WAHL

Reloading is to a shooter what darkroom work is to an amateur photographer: an interesting hobby within a hobby that not only makes the main activity more fun and more skillful, but can be justified as a real money-saver, to boot.

Homemade ammunition isn't new. Shooters have been "rolling their own" since about 1870, when the metallic cartridge came into general use. Interest in reloading really started to grow after World War II. Recently, it has snowballed, and today there are an estimated two million reloaders in this country—

## How to reload a cartridge with a hand tool

DECAPPING

RESIZING

PRIMING

**Pocket-sized Lee Loader** consists of decapping chamber, decapping punch, priming chamber and bullet seater, priming rod, body (resizing die), and fixed-charge dipper for measuring powder. Only other



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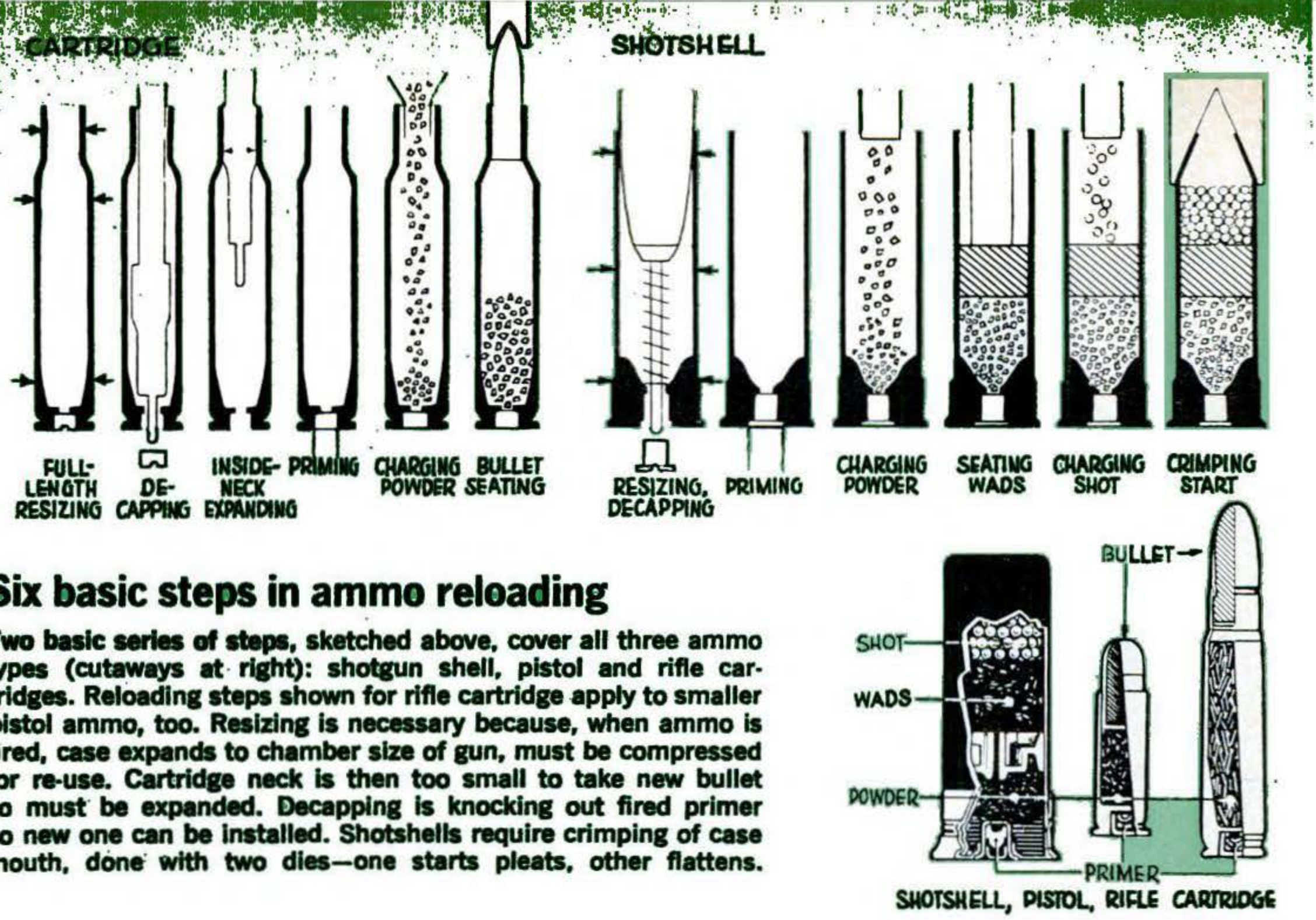


## Six basic steps in ammo reloading

**Two basic series of steps, sketched above, cover all three ammo types (cutaways at right): shotgun shell, pistol and rifle cartridges. Reloading steps shown for rifle cartridge apply to smaller pistol ammo, too. Resizing is necessary because, when ammo is fired, case expands to chamber size of gun, must be compressed for re-use. Cartridge neck is then too small to take new bullet so must be expanded. Decapping is knocking out fired primer so new one can be installed. Shotshells require crimping of case mouth, done with two dies—one starts pleats, other flattens.**

probably five times as many as there were 20 years ago.

**Everything you need.** Supplying components and tools is big business. Tools range from a simple pocket kit (photos below), at $9.95, to sophisticated machines like the RCBS Rock Chucker Press, shown (facing page) on the loading bench of J. W. Hornady, bullet maker and author of one of the reloading handbooks listed at the end of this article. This press costs $61.50 (with dies for one caliber); it does the same job as the tool below, but faster.

**Why reload?** One big reason for reloading is economy. Faced with the ever-rising cost of ready-made ammo, for many men it's the only way to keep shooting regularly. After wartime price ceilings

*Continued*

things you'll need are a small mallet (for four steps shown) and bullets. Available in most popular rifle and pistol calibers, the loader sells for $9.95. There's a similar tool for shotshells at same price.



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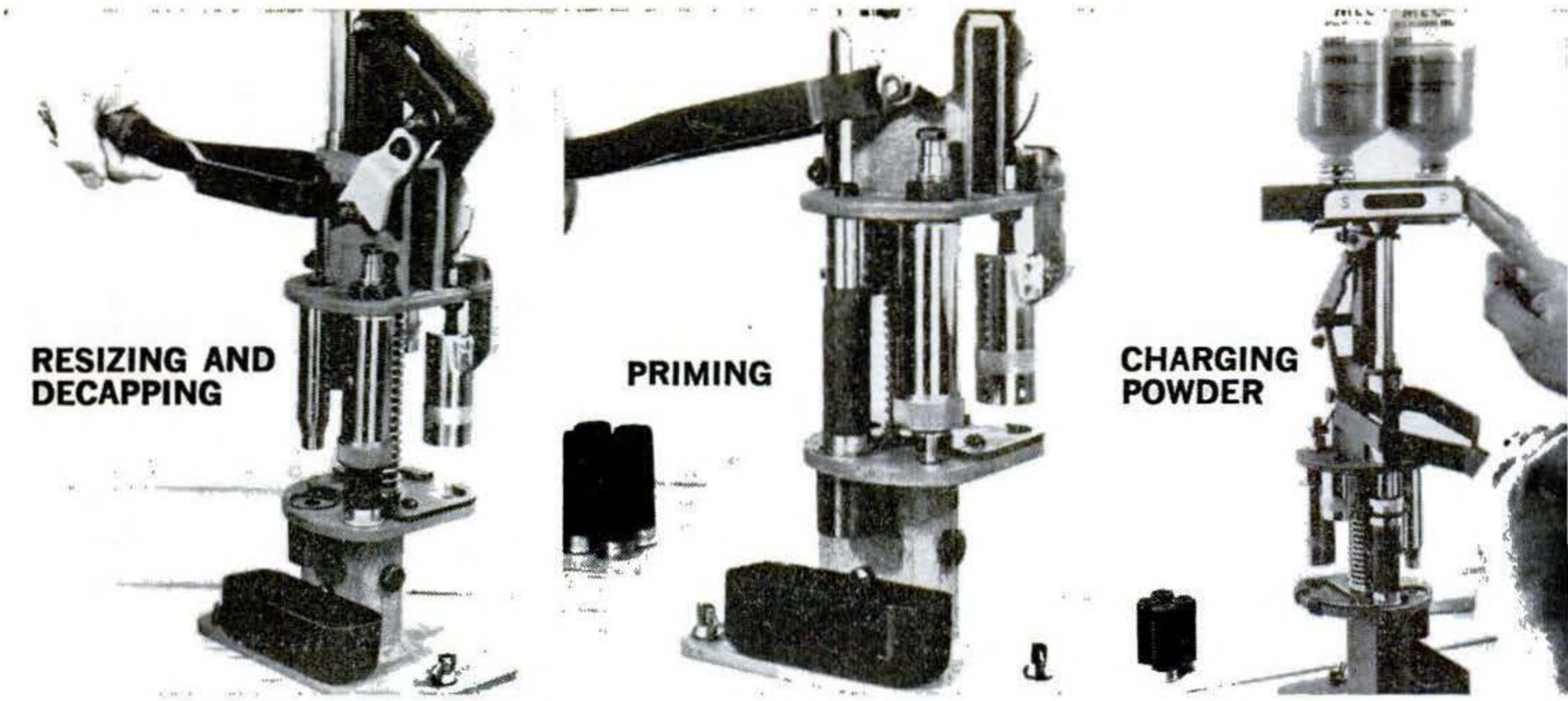



## How to reload a shotshell with a bench tool

**Tool demonstrating steps** is MEC 600 Jr. Reloader, capable of loading up to 300 shotshells an hour. Old shell is started into reconditioning die and handle depressed; spent primer drops into catcher and metal base is resized. In center, new primer has been placed in seating assembly, shell slipped on reprime punch, handle depressed. Right, rammer tube is inserted and bar is moved to drop powder.

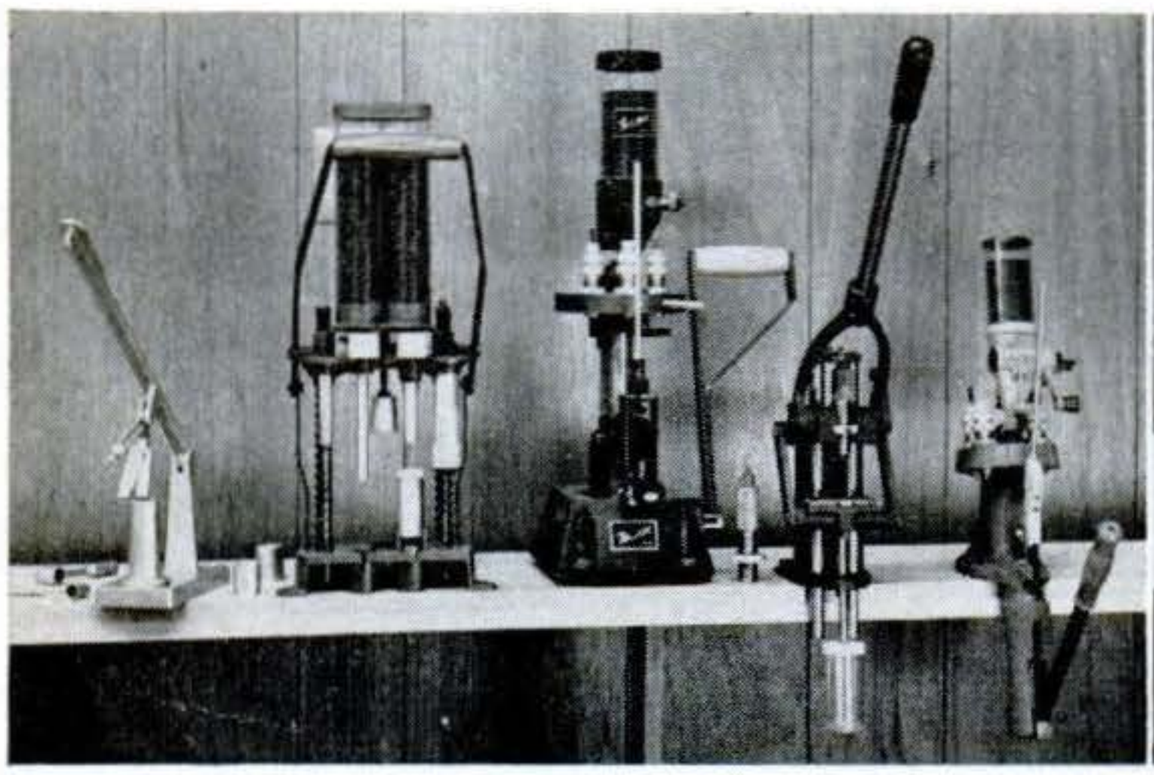
were removed in 1946, a box of 12-gauge trap loads cost $1.23. A shooter now pays $3 for those same 25 shotshells. By reloading, he can shoot for not much more than '46 prices—or, put another way, he can do more than twice as much shooting for the same money.

When you eject a fired case from your gun, you're throwing away the most expensive component—generally, half the total cost of the round. The fact that this hull can be re-used many times makes reloading practical.

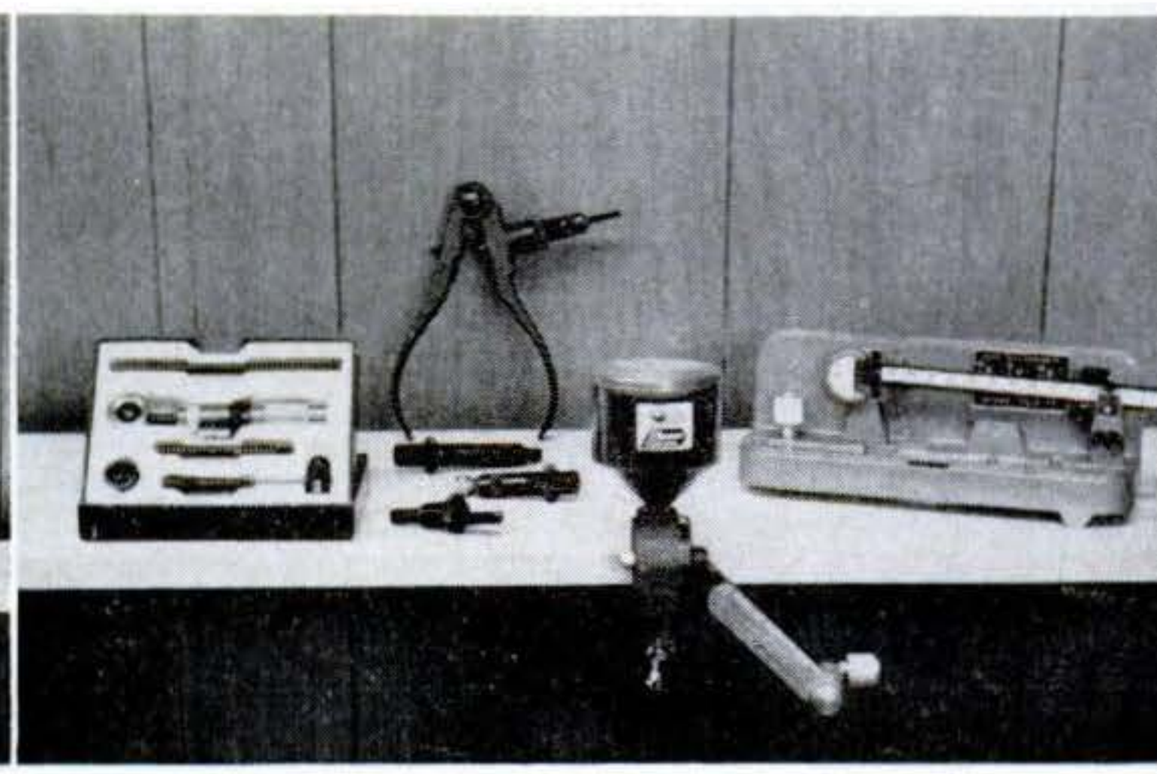
We're talking about reloading rifle and handgun cartridges, as well as shotgun shells. It's not feasible to reload rimfires like .22 Short and Long Rifle.

Perhaps more important than economy to the serious marksman is the fact that he can make better ammunition than he can buy. Commercially loaded ammo is good, but it's necessarily designed to shoot satisfactorily in *all* guns of a given caliber or gauge—and individual firearms are notably selective when it comes to their fodder.

Superior accuracy can be obtained with reloaded ammunition because the shooter



**Bench loading tools** not shown in demonstration photos are (left to right): for shotshells—Safari 12-Gauge ($20) and Lyman Easy ($49.50), which handles 200 loads an hour; cartridge presses—Texan 101-T-11 Turret ($140), Bonanza Co-Ax with snap-out dies ($68.45)—both new; Lyman Spar-T Turret ($68).



**Tools and accessories** for hand-loading cartridges include (from left) the $10 Lee Loader, shown in use on previous pages, and pliers-like Lyman 310 ($16.50). Unless you use dripper (supplied with Lee) you need Bonanza bench-rest powder measure or Lyman-Ohaus M5 scale—each $22.50.



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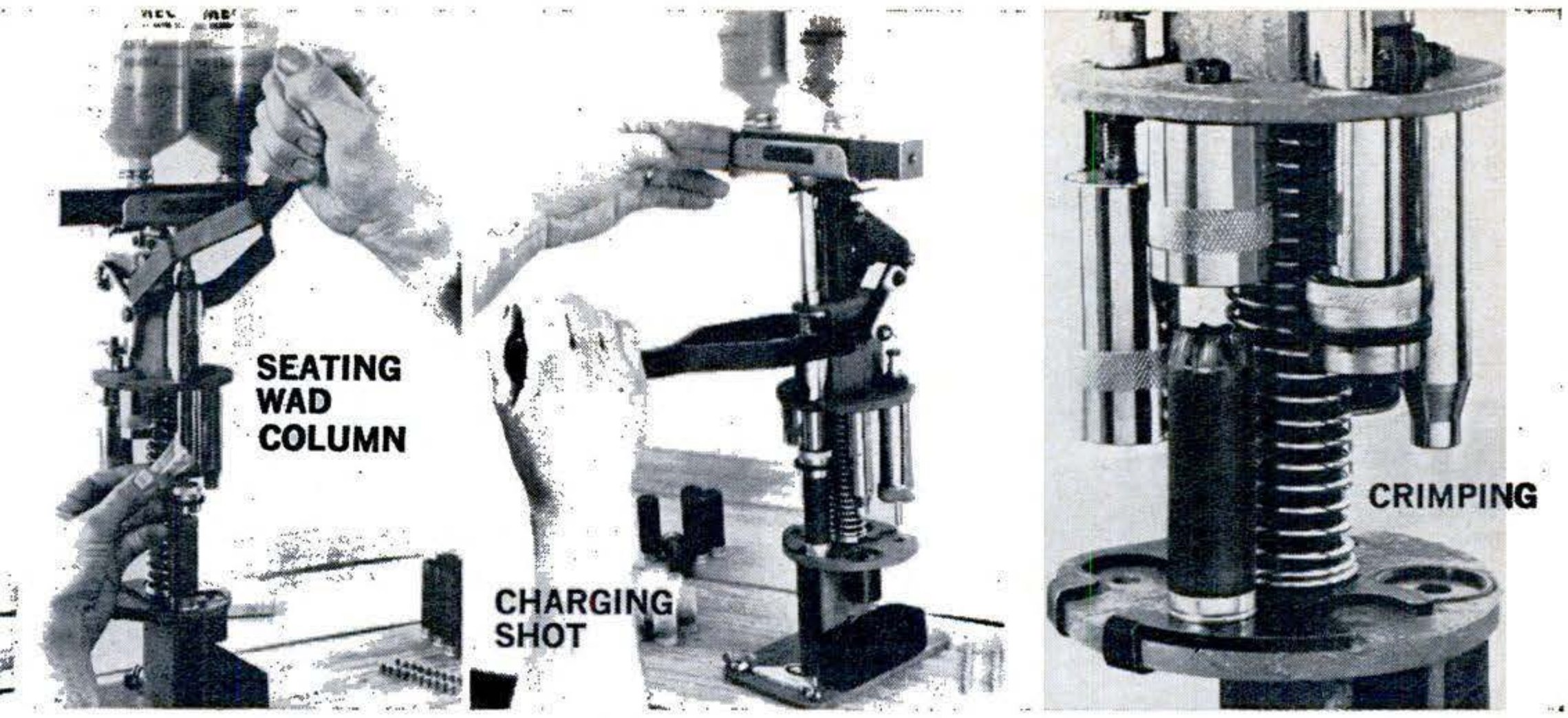


**As handle is raised** until rammer tube clears shell, plastic wad column is placed in wad starter. Handle is depressed to positive stop, held down while shot is charged by pushing bar to right (as seen in the center photo). The result following first crimping step is shown at the right. The crimp starter has repleated mouth of case in original folds. Next, shell will be placed under cam-operated crimping die and handle depressed to complete job. Machine in use here sells for $65. You can buy a tool for $10 to accomplish the same results, but doing each step by hand, the job goes more slowly.

can vary powder charges, primers, and bullets or shot (within prescribed safe limits) to customize ammunition for optimum results with a specific gun for a specific kind of shooting—target or game.

**Those old guns.** If you own an obsolete firearm for which no factory ammo is available, reloading can keep it firing. Even if cases aren't available, they can usually be made by reforming brass of another caliber. You'll find instructions in *Home Guide to Cartridge Conversions* by Maj. George C. Nonte Jr. ($8.95 from Stackpole Books, Harrisburg, Pa.)

Small-arms primers and smokeless powders aren't dangerous to store and use in the home. These powders are comparatively difficult to ignite, and in an ordinary fire there is no explosion. Detonation occurs only when burning powder is closely confined, as in a gun.

Often, two shooting pals—or a gun club—will form a partnership to share the tooling expense. But even on your own, if you shoot regularly, it shouldn't take long for the savings to pay off your investment. If you spend $50 for a shotshell loader, for example, you'll save that much on the first 700 12-gauge shells you load with it (3½ hours' work). And savings on just three boxes of .30-06 cartridges pay for a $10 loader. No wonder there's a big boom in reloading. PS

## Choose a book to get started

A novice needs more detailed instructions than an article can supply. Before purchasing any equipment, study a good handbook on the type of reloading you want to tackle.

**Hornady Handbook** **$3.50**
**Hornady Mfg., Box 1848, Grand Island, Nebr.**

**Lyman Reloading Handbook** **$3.50**
**Lyman Gun Sight Corp., Middlefield, Conn.**

**Speer Manual** **$2.95**
**Speer Inc., Box 244, Lewiston, Idaho 83501**
Books above are the three bibles for the reloader. Hornady's is for riflemen only.

**Handloader's Digest (4th Edition)** **$4.95**
**Gun Digest Co., 4540 W. Madison, Chicago 60624**
Complete guide, including up-to-date catalogue section on available tools, supplies.

**Reloader's Guide by R. A. Steindler** **$3.95**
**Stoeger Arms Corp., 55 Ruta Ct., So. Hackensack, N.J. 07606**

**Lee Reloading Handbook** **98¢**
**Lee Custom Engineering, Inc., Hartford, Wis.**
Of special interest to users of Lee Loaders.

**DuPont Handloader's Guide** **Free**
**E. I. DuPont Co., Chemical Prod. Sales Div., Explosives Dept., Wilmington, Del. 19898**

**Hercules Smokeless Powder Guide** **Free**
**Hercules Inc., Explosives and Chemical Propulsion Dept., Wilmington, Del. 19899**
Both offer recipes for safe, effective loads, developed and tested by ballisticians.

**Handbook for Shooters and Reloaders, 2 vols. $15**
**Pocket Manual for Shooters and Reloaders $3.**
**P. O. Ackley (author), 2235 Arbor Lane, Salt Lake City 84117.**
Handbook contains advanced information not available elsewhere; Manual includes loading data on over 100 popular calibers.



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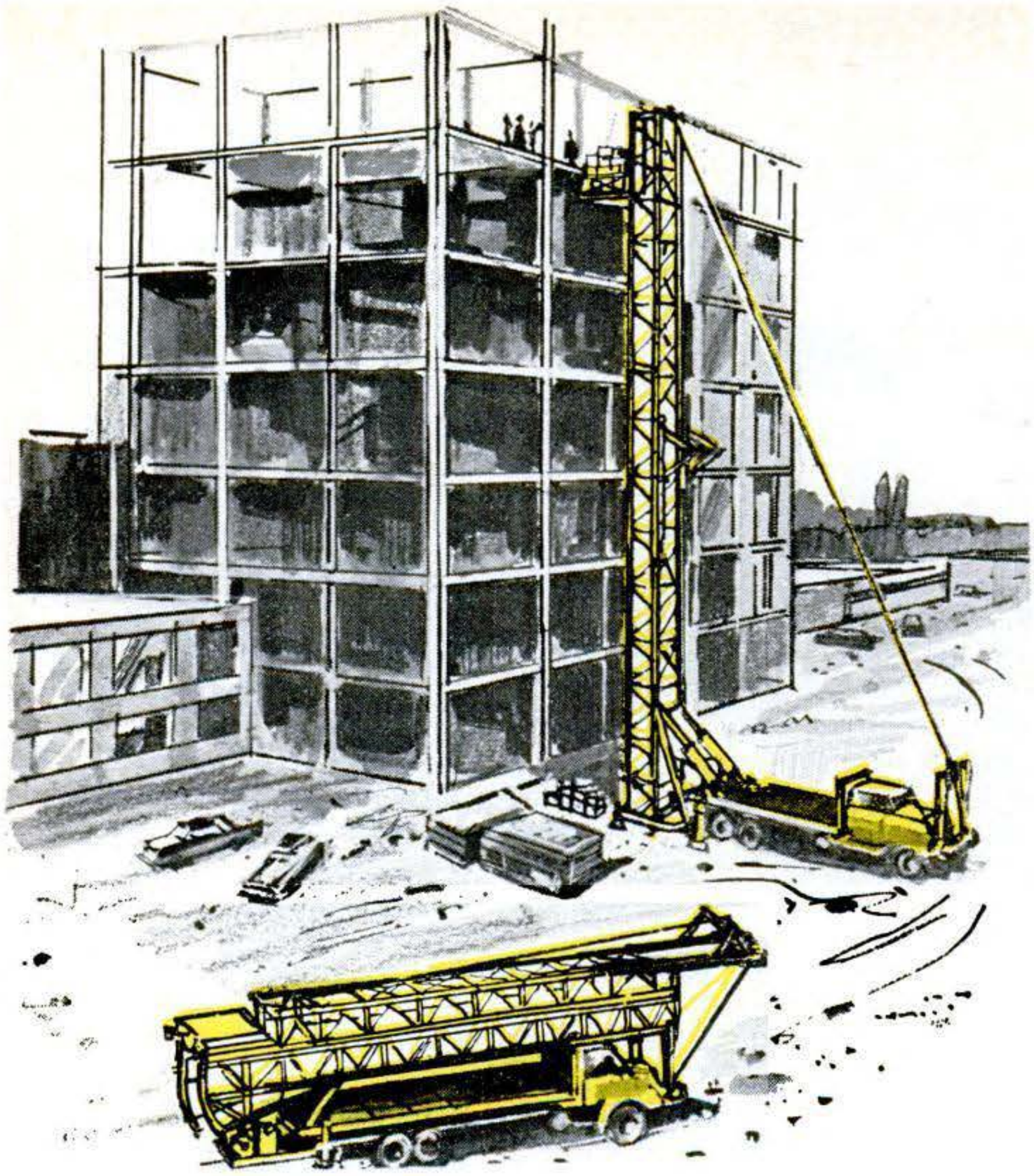
# New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMORE



**Elevator rides to the job.** Construction and repair work requiring the lifting of heavy material might be speeded and simplified by this recently patented hoist. Folded in sections, it would ride to the site on a truck. Winching a cable would then straighten and erect the mast. The truck's engine could also be used to raise and lower a freight platform that would ride up and down the mast.

**Rim driver turns ship's propeller.** A ship's engine would not have to be centered in the lower hull if it could transmit power through the rim of a shrouded screw. Or the engine—or engines—could be raised, to permit a sleeker hull contour with smoother water flow through the prop. The inventor claims the combination could result in improved efficiency and reduced vibration.

**Chemical jacket cools beverage can.** Capsules of chemicals that cool rapidly when mixed might make it possible to chill a canned food or beverage quickly when you want to serve it. The capsules would be packed in a double-walled plastic cylinder fitted tightly around a standard can. To cool the can, you'd squeeze the plastic to break the capsules and mix the chemicals together.



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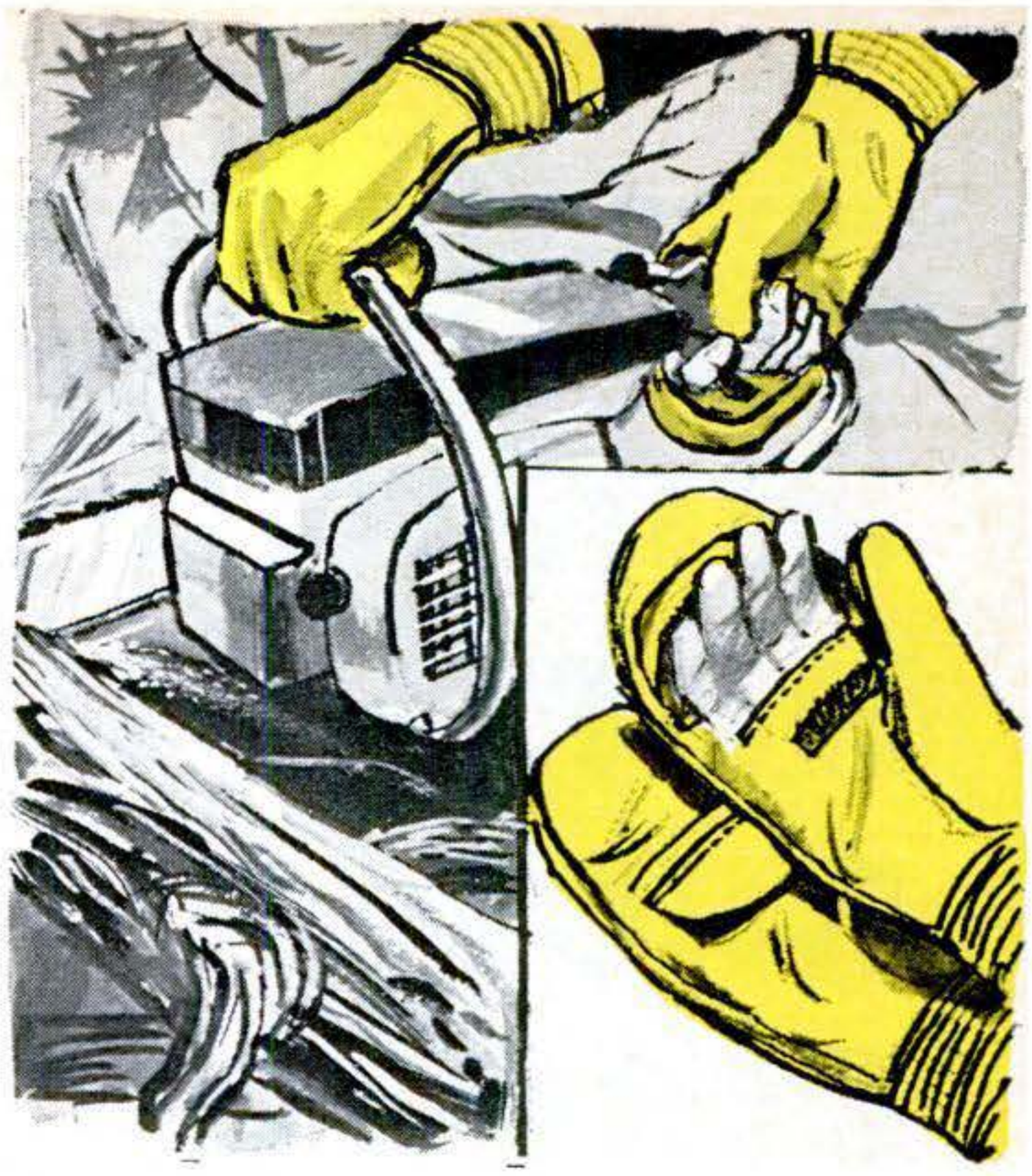
**Drip shield aligns itself.** A curved slot in this spatter shield would help keep it between you and the paint roller. Friction on a spring pin in the slot causes the shield to follow the handle angle until a wiper edge touches the surface just ahead of the paint. On the reverse stroke, it turns the other way until stopped by the opposite wiper.



**Mitten flap frees fingers.** You wouldn't have to take these gloves off to manipulate tools or use one or more fingers. A slit would let you expose fingers when necessary while keeping the rest of your hand warm. A flap over the slit could be closed with strips of napped fabric that hold tightly when pressed together but release when lifted.

**Spare trunk rises for access.** Secured to the fenders and rear deck of a car, this luggage box might add the extra capacity you need for vacations or long trips. It could be lifted off for loading or unloading, or be raised on its hinged arms to permit free access to the trunk. Padded bumpers and a tiedown would keep it snug in transit.

---

*The following patents have been granted on these inventions.* **Mobile elevator**—*No. 3,367,448 to W. A. Wille, Long Grove, Ill.;* **Rim-drive prop**—*No. 3,361,107 to E. R. Weber, Rowayton, Conn.;* **Cooling jacket**—*No. 3,379,-025 to W. R. Donnelly, Piqua, Ohio;* **Drip shield**—*No. 3,378,872 to E. F. Frontera, Verona, and R. C. Michelfelder, Wanaque, N. J.;* **Slitted glove**—*No. 3,299,441 to M. L. Slimovitz, Newbern, Tenn.;* **Spare trunk**—*No. 3,371,831 to S. C. Schaeffer, Avoca, Minn.*

*Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D. C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.*



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## Snowmobile fever turns on the

# WINTER'S HOTTEST RACING CIRCUIT

**Ski-scooter jockeys are burning up snow tracks at speeds of up to 90 m.p.h. in pursuit of cold cash**

**Snowmobiles zoom around course at W**

**Drivers lean into turns** like this one, using body English to avoid tipping at high speeds.



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llowstone, Mont., in one of year's biggest events—and the one that closes year's competition.

By HERBERT SHULDINER

A frosty new speed mania is adding to the boom in our fastest-growing big-league racing sport. The winter madness called snowmobile racing has drawn thousands of racers who this year will compete for big cash prizes in dozens of meets from New England across to the Pacific Northwest.

If you've been bitten by the racing bug, there are plenty of opportunities for you to join in the fun that begins early next month and lasts until April begins to melt away.

There are events for every type of snowmobile, from stock-machine races with engines of only 10 hp. and 250cc on up to modified classes with engines of almost 800cc displacement and almost 60 hp. The largest stock-engine displacement is 400cc. Anything above that is auto-

*Continued*

**Cornering on Eagle River, Wis., oval** gets a little slippery as drivers fight for the lead, competing for prize money.

**Snowmobile hoods** have extra-large front vents for racing, to give the engine maximum ventilation.



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Start of race at Lake Placid, N.Y., sends scores of drivers roaring over the frozen lake surface.

matically in the modified class. Almost all meets pay cash prizes to winners, and only a few run for trophy awards.

The richest races of the year are held during January in Rhinelander, Wis., with $25,000 in prizes offered, and a few miles away, in Eagle River, Wis., with another $25,000 in prize money. At Brainerd, Minn., some $10,000 will be up for grabs in races run on the famous three-mile Donnybrooke sports-car track. Perhaps the biggest single prize of all goes to the winner of the 500-mile Winnipeg to St. Paul race—$5,000. Other important events are held in West Yellowstone, Mont.; Lake Placid, N. Y.; Pennsylvania's Pocono Mountains; and Laconia, N. H.

It doesn't cost much to get started in snowmobile racing. Machines with low-horsepower engines start at about $700, and entry fees for races are only $15 to $20 per event.

**Getting ready.** Snowmobile racing requires more than just nerve and a competitive bent. Skilled hands and mechanical knowhow are just as important in preparing a snowmobile before a race as the driving you do during the sprint to the wire. In stock events, with evenly matched rigs, the race is often won by the one that stands up best.

Drivers literally take their machines apart and put them together again before they race. The biggest effort goes into the engine, to get those extra couple of horsepower that make a winner.

Intake and exhaust ports are polished with a grinding stone to increase the velocity of the fuel-air flow and get maximum scavenging. Some meets allow you to use high-compression heads and a racing piston. But you're not permitted to overbore the cylinder, which would increase engine displacement.

Much effort is made to reduce back pressure on the engine, and draw exhaust out without losing power. Some races permit megaphone mufflers, which improve scavenging, and boost power.

"Stuffing the crankcase" is another technique. This makes the engine rev higher—but don't overdo it, or you won't get off the line; you'll lose too much in the lower range. Drivers toy with spark-plug heat range, too, varying plugs to prevent fouling or preignition.

**How fast do they go?** In stock races, speeds of 55-60 m.p.h. are common, even with small 250cc engines. In modified races, speeds of 80 and 90 m.p.h. have been achieved under ideal conditions.

Such speed, in temperatures that frequently dip below zero, sometimes give drivers frostbite, but the competition gets hotter all the time—and this winter's races shape up as the best yet. PS

**Drivers maneuver** to avoid racer who has spilled off his ski scooter at this meet at Eagle River.



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PERSONAL-USE REPORT:

# Pint-Size Welding Torch

## Does it bring welding within the scope of all home shops?

By BOB GILMORE

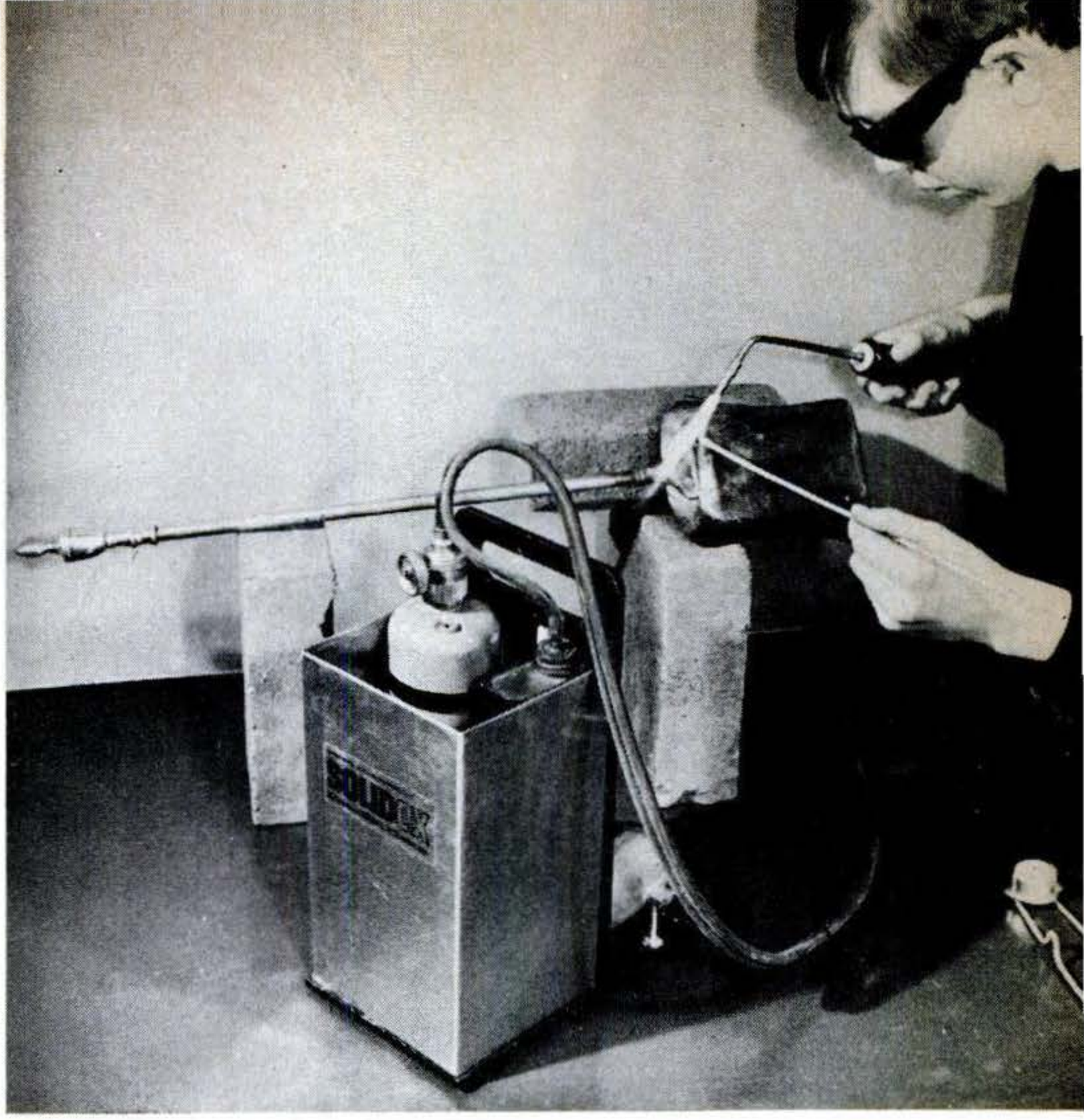
Now that I'm thoroughly acquainted with the Solidox torch from several months of trying it in every sort of welding situation, I'll confess I almost sent it back the day it arrived.

For all the 28 years I've known how to weld, I've wished I could have my own oxy/gas outfit instead of having to borrow one or bother my friends in their shops when I had something to flame together.

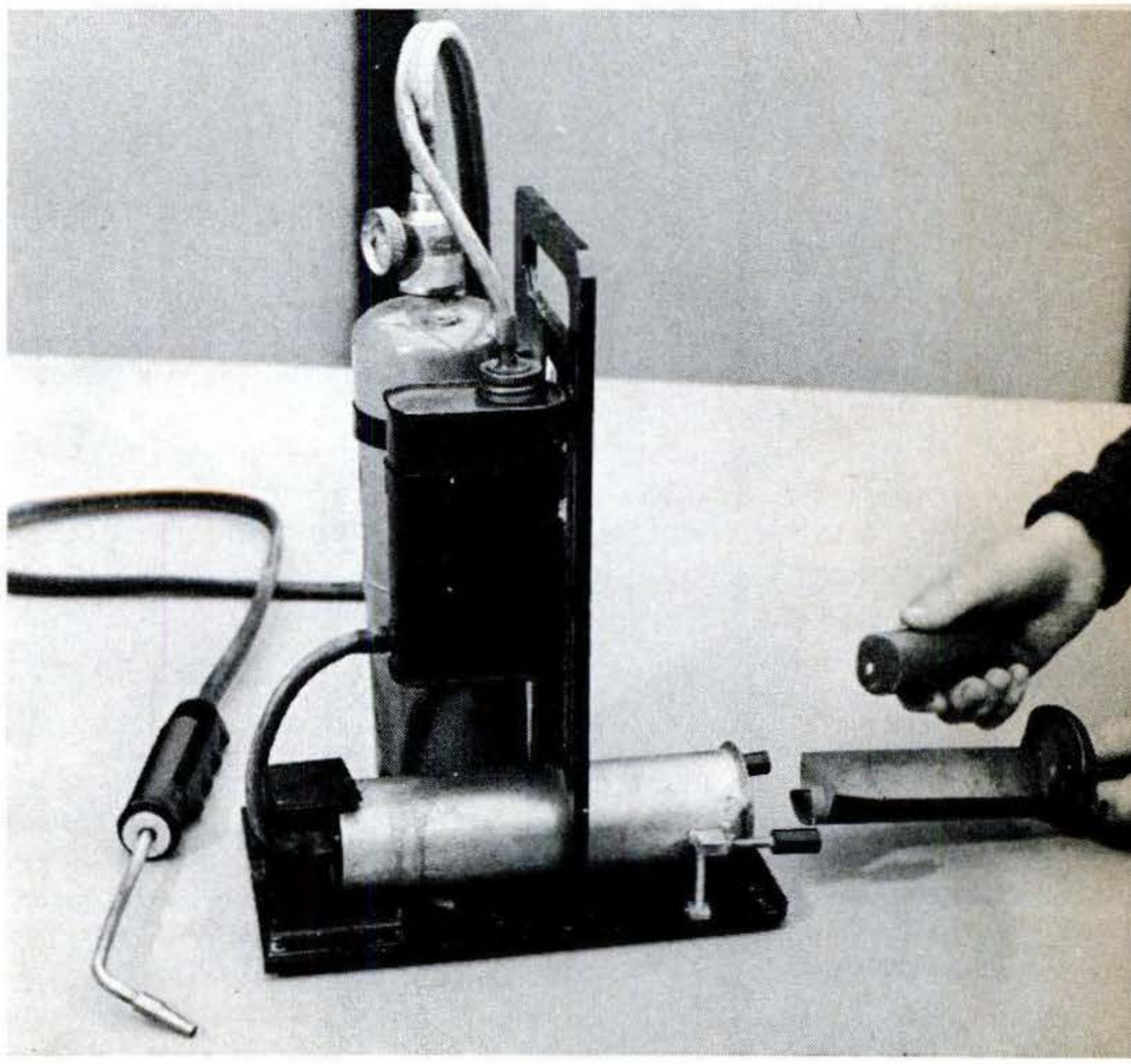
But buying the standard setup of torch and tips, hoses, pressure gauges and regulators costs at least $100. Then, just the medium-sized set of tanks (100 cubic feet for oxygen, 80 for acetylene or propane) would cost around $87 to buy, $3 and $3.50 to fill or refill. Even to rent such a set would cost five cents a day per tank, or $36.50 per year.

Obviously, shelling out that kind of money would

[Continued on page 194]




**Capable of many a man-size job** (above), the Solidox rig is small, safe, and simple enough for beginners of any age. You light the solid oxygen pellet like a safety match (below) by scratching white tip, then seal it inside cylinder on curved tray. Released oxygen pushes through filter in cylinder end, up through can of alumina pellets (to dry out), then through hose to join propane in torch.





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# Gus and the Backward Battery

**Harry's foreign sedan was in A-1 shape—except for the radio, clock, tach, gas gauge, and battery. "Easy," said Gus**

By MARTIN BUNN

"It's obvious that I can't sell the Model Garage any more insurance today, Gus, so I'll take my tank of gas and go," said Harry Douglas, as he hoisted his lanky six-foot frame from the wooden bench opposite Gus Wilson's desk. "In case you change your mind . . ."

"I know where to reach you!" interrupted Gus, grinning. "In the past month you've sent me two letters and three postcards, all printed with your address and phone number."

Douglas grinned in return. "Guess that's what happens when the son of a good friend becomes the town's newest insurance agent."

Outside, a 1964 Volvo sedan stood idling next to the line of gas pumps. Stan Hicks, Gus's assistant, was busily polishing its windshield.

"Check the oil?" asked Stan.

"Not unless you can do it with the engine running," answered Douglas. "I doubt if it will start again if you switch it off. My wife left the headlights on last night. I had to use jumper cables and the battery in a neighbor's car to start up this morning."

Gus chuckled. "No problem. We'll give the battery a quick boost."

Douglas glanced at his watch. "No time now," he said. "Anyway, my last appointment this morning is several miles out on the main road. I'm meeting a claim adjuster to look over the scene of a three-car crack-up, and the drive there should help recharge the battery. I'll leave the engine idling while I make my next few calls."

He slid into the driver's seat, and an instant later popped his head out of the side window. "Hey, Stan, I asked you to fill it up."

"The tank *is* full," said Stan.

"You can't tell by the gas gauge," said Douglas. "The needle reads 'empty.' Guess it's broken, too."

"Probably nothing serious," said Gus. "A blown fuse, or maybe a short in the wiring from the tank sender unit."

Douglas looked glum. "This seems to be my day for car troubles. The radio wouldn't work this morning, along with the electronic tachometer and the clock. And now the fuel gauge. Gus, as soon as things stop breaking down, I'll bring the car in so you can fix the lot."

Douglas tromped on the accelerator, and wheeled the Volvo into the street before Gus could say anything, but Stan recognized the thoughtful expression on Gus's face.

"It bothers me too, boss," he said. "Those accessories work off different fused circuits, so the trouble couldn't be a single short or a blown fuse."

The look on Gus's face suddenly turned into a frown. "But a reverse-charged battery would explain everything," he exploded. "None of those accessories would work if the battery polarity is reversed—as it would be if Harry hooked up the jumper cables backward this morning."

**Gus spun around** and dashed into the office, with Stan close behind. "Stan, we've got to find Harry before he gets to that last appointment this morning. I could kick myself for not thinking about everything sooner."

"I . . . I don't understand," Stan said.

"Unless we can stop him," said Gus, reaching for the phone, "there's a 50-50 chance that Harry will burn out the Volvo's generator and part of the wiring harness the instant he switches off the engine." But his call was fruitless.



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Gus flung open his door and jumped out of the cab, bellowing at a bewildered Harry Douglas: "Don't turn it off! Don't turn it off!"

ILLUSTRATION BY RAY QUIGLEY

What was left of the morning passed very slowly. Harry Douglas worked out of a one-man office, without a secretary, and his telephone answering service didn't have a list of his appointments for the day. Neither did his wife. Now Gus and Stan waited for the phone call they hoped wouldn't come: from Harry asking them to tow his car to the Model Garage.

It was a welcome distraction when a 1968 Dodge Charger pulled up in front of the office, with a familiar face behind the windshield.

"That's the fanciest police cruiser I ever saw," called Gus. "No wonder our taxes are up this year."

State Trooper Jerry Corcoran, dressed in off-duty civvies, climbed out of the front seat and winked slyly. "Just between you and me, this car can outrun most of the cars in our fleet. It's a good

*Continued*



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thing I'm a law-abiding citizen on my days off."

Stan cocked his ear next to the hood. "The idle sounds a bit rough today."

"That's exactly why I'm here. The engine runs rough at all speeds, and it misfires a lot. I think the tune-up you did last week wore off."

"Impossible!" Stan sputtered.

"Improbable, Stan," said Gus, "but not impossible. Let's have a look."

A small metal box bolted to the left fender pan caught Gus's eye as he raised the hood. "I see you've installed a capacitor-discharge ignition system," he said. "Did the misfiring begin right after you installed the system?"

"Yes," Jerry admitted. "But it's only a coincidence . . ."

Without answering, Gus carefully loosened the distributor-locking clamp, and slowly rotated the distributor body to retard ignition timing slightly. Immediately, the rough idle smoothed out.

"Same old problem?" asked Stan, a triumphant smile on his face.

"Seems like it," answered Gus, and turned to Jerry. "It's what Stan and I call a 'short spark.' "

"I've heard of a short circuit," said Jerry, looking baffled, "but never . . ."

"Jerry!" Gus interrupted. "Talking of short circuits, you're the one man who can help me." Gus grabbed the startled trooper by the arm, and pulled him toward the tow truck.

"Jerry, this is important," he said. "Do you know the location of a recent three-car accident? On the highway?"

"Sure," Jerry said, "it's about eight miles north of town."

"Come on . . . you guide me out there," Gus said. "Stan will have your car fixed by the time we get back."

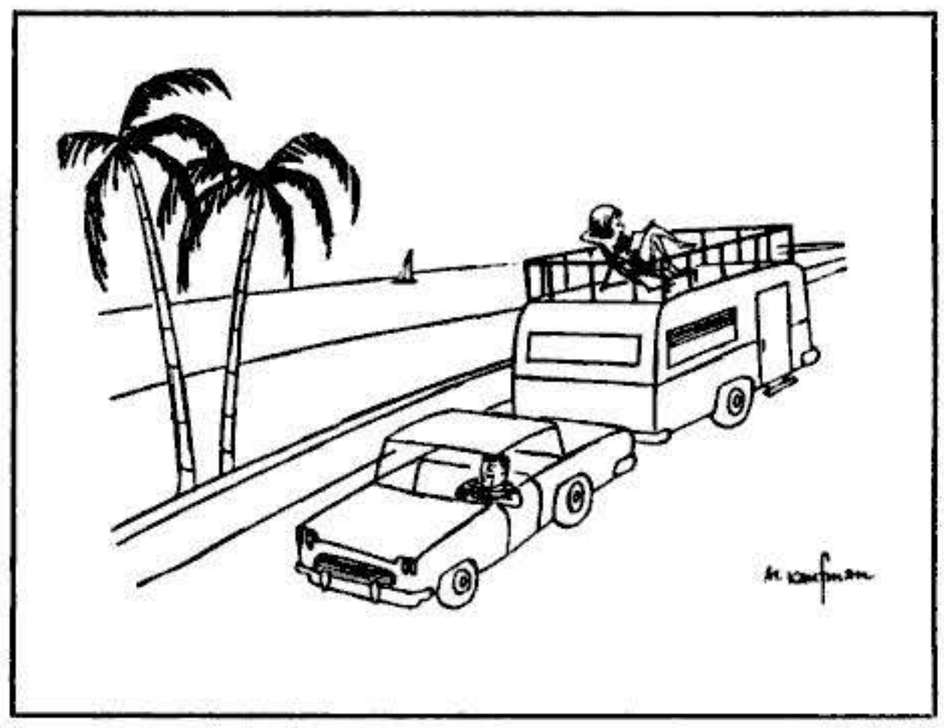
**Jerry Corcoran** bounced up and down in the passenger seat, occasionally giving Gus a direction. Finally, he said, "Since I'm along for the ride, would you please explain what a short spark is? I'm getting more curious by the minute."

"Well," Gus said, "as you know, a C-D system delivers high-voltage pulses to the ignition coil, which transforms them into 25,000-volt-plus pulses that fire the spark plugs. These pulses are uniform, no matter what the engine r.p.m. That's why a C-D system improves starting and high-speed performance."

"So why the misfiring?" asked Jerry.

"Because the C-D system you installed, like many on the market, produces a very-short-duration spark—it lasts a shorter period of time than the spark from a conventional ignition.

"Some high-performance engines—like your big V-8—balk at the short spark: It doesn't always ignite the mixture properly. When I retarded the timing a bit, back at the garage, it allowed the air/gas mixture to stabilize longer inside the cylinder, before the spark ignited it, insuring proper ignition."



"Do I have to take the system out?" asked Jerry. "Or is there another cure?"

"There is," replied Gus. "A very simple one. Stan will increase the gap of all eight spark plugs to about 0.045 inches. This lengthens spark duration, but . . ."

"There's a catch?" interrupted Jerry.

"Sort of," said Gus. "Increasing the gap also raises the voltage of the coil's output pulses above 25,000 volts. This new level may be more than your present ignition wiring can take, so Stan may also have to replace it with special extra-high-voltage cable."

"Fair enough," said Jerry. Then: "Hey, Gus, the accident spot is just ahead on the right."

Gus scanned the scene. Three cars were jumbled at the side of the road, but no Volvo was in sight. As he pulled up, he glanced at the rear-view mirror—and jammed on his brakes. Harry Douglas' car was rolling to a stop just behind the tow truck.

Gus flung open his door and jumped out of the cab, bellowing at a bewildered Harry Douglas: "Don't turn it off! Don't turn it off! Keep it running!"



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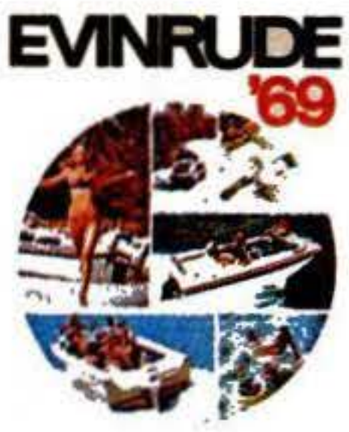


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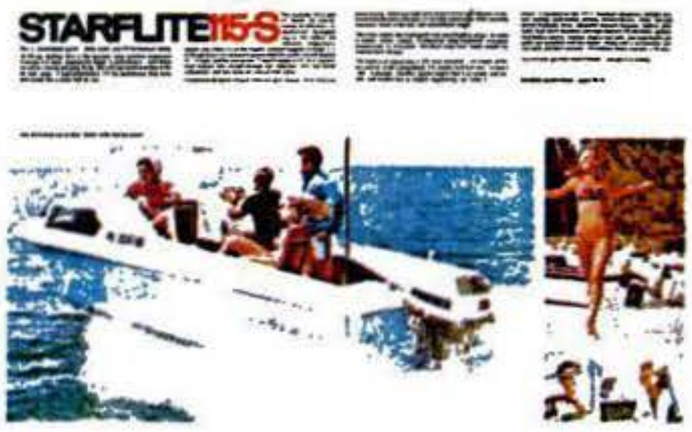

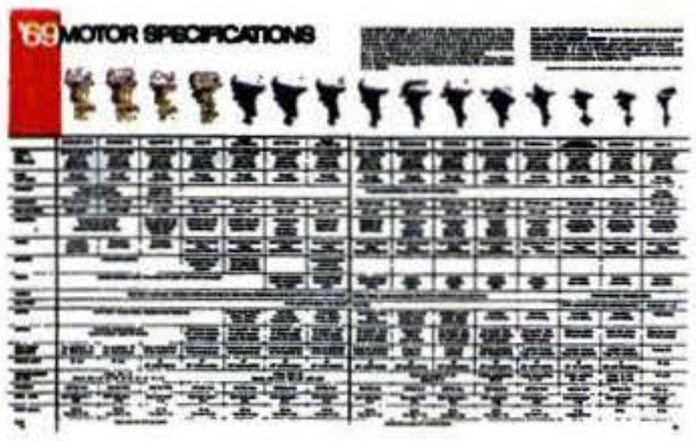

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"Gus . . . what are you doing here?" Harry Douglas stammered.

"Trying to save you some money," Gus said as he reached into the car to pull the hood-release lever. "Whatever you do, don't touch the ignition key. I need some test gear from my truck. I'll be right back."

**A quick voltmeter check** proved that Gus's hunch was right: The battery was reverse-charged. Deftly he disconnected the terminal clamps, and breathed a sigh of relief.

"I'm sure glad you aren't on time for morning appointments," he said.

"I was here 15 minutes ago," said Douglas, "but while our adjuster was taking pictures of the scene, I went for a sandwich." He pointed to a heavy-set man down the road busily working with a camera.

"Now tell me how disconnecting the battery cables will save me money."

"This morning," Gus explained, "you hooked up the jumper cables backward—plus to minus and minus to plus. A mistake like that might have caused a partially discharged battery to explode—I've seen it happen—but your battery was totally dead, so nothing happened."

"But the car started okay," said Harry.

"Right," said Gus. "The starter motor is series-wound, so it will turn in the proper direction regardless of battery polarity. And the ignition system will work also.

"The generator is the trouble maker, though. The first surge of backward current through its field coils repolarized it, reversing its output voltage polarity. All morning you've been driving a *positive-ground* car. That's why your accessories, designed for negative-ground operation, didn't work.

"Worse yet, the generator has been reverse-charging your battery. The battery has been *reformed*—in other words, its internal polarity has been switched. Its positive plates are now negative and its negative plates positive."

"Doesn't sound good for the battery," said Harry. "Is it ruined?"

" 'Fraid so," admitted Gus. "But that may not be the worst of it. Kill the ignition and we'll find out."

A continuity proved the point: The voltage regulator's cut-out relay contacts were frozen together.

"The sudden surge of repolarizing current through the generator welded the contacts," Gus explained. "They're supposed to open when the generator stops producing an output voltage. If they don't, the generator's armature windings become a direct short circuit to ground for the battery. If you had turned off the engine before I disconnected the battery cables, there'd have been an enormous current flow—for just long enough to burn out the windings and the cables linking the battery and generator."

"Ouch!" said Harry. "I guess I owe you a vote of thanks, and a favor in return for this mission of mercy."

"Right," said Gus. "And you can pay your debt easily."

"How's that?"

"By passing the word around among your colleagues that I have all the insurance I'll need until 1999." PS

## French vehicle goes anywhere

The Castor is a zippy little all-terrain rover. It has a three-forward-speeds transmission (no reverse) and a 175cc. engine, and can do up to 37 m.p.h. on land, six or seven knots in water. The vehicle weighs about 385 pounds and is made of fiberglass-reinforced polyester. It was recently introduced at a Bordeaux sports show.



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# 1969 Buick Sportwagon.

## No wonder Buick owners keep selling Buicks for us.

The 1969 Buick Sportwagon.

It's a Buick owner's way of saying station wagon. Elegantly.

Outside, there's distinctive simulated wood-grained side paneling that's yours for the ordering.

Inside, there's 100 square feet of load area, rugged expanded-vinyl seats, a padded instrument panel.

And the 1969 Sportwagon's long list of standard equipment includes a big 350 cubic inch V8, plus a new dual-action tailgate for easy loading and unloading.

Let's not forget Sportwagon's impressive list of safety features, either. Features like side marker lights, an energy-absorbing steering column and passenger guard door locks.

That's a Buick owner's way of saying station wagon. See if your Buick dealer doesn't respond the same way.

Elegantly.

With a 1969 Buick Sportwagon.

## Wouldn't you really rather have a Buick?

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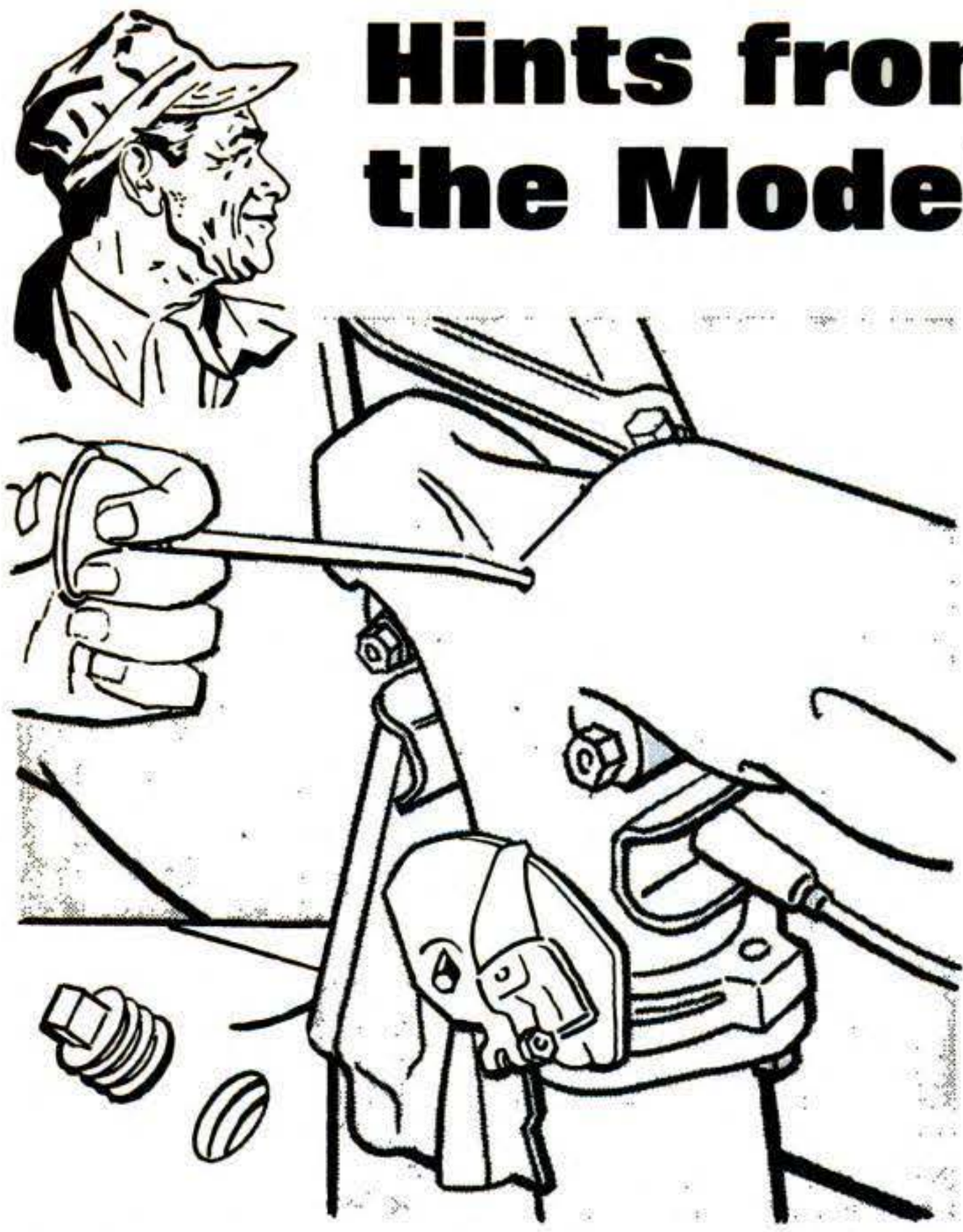
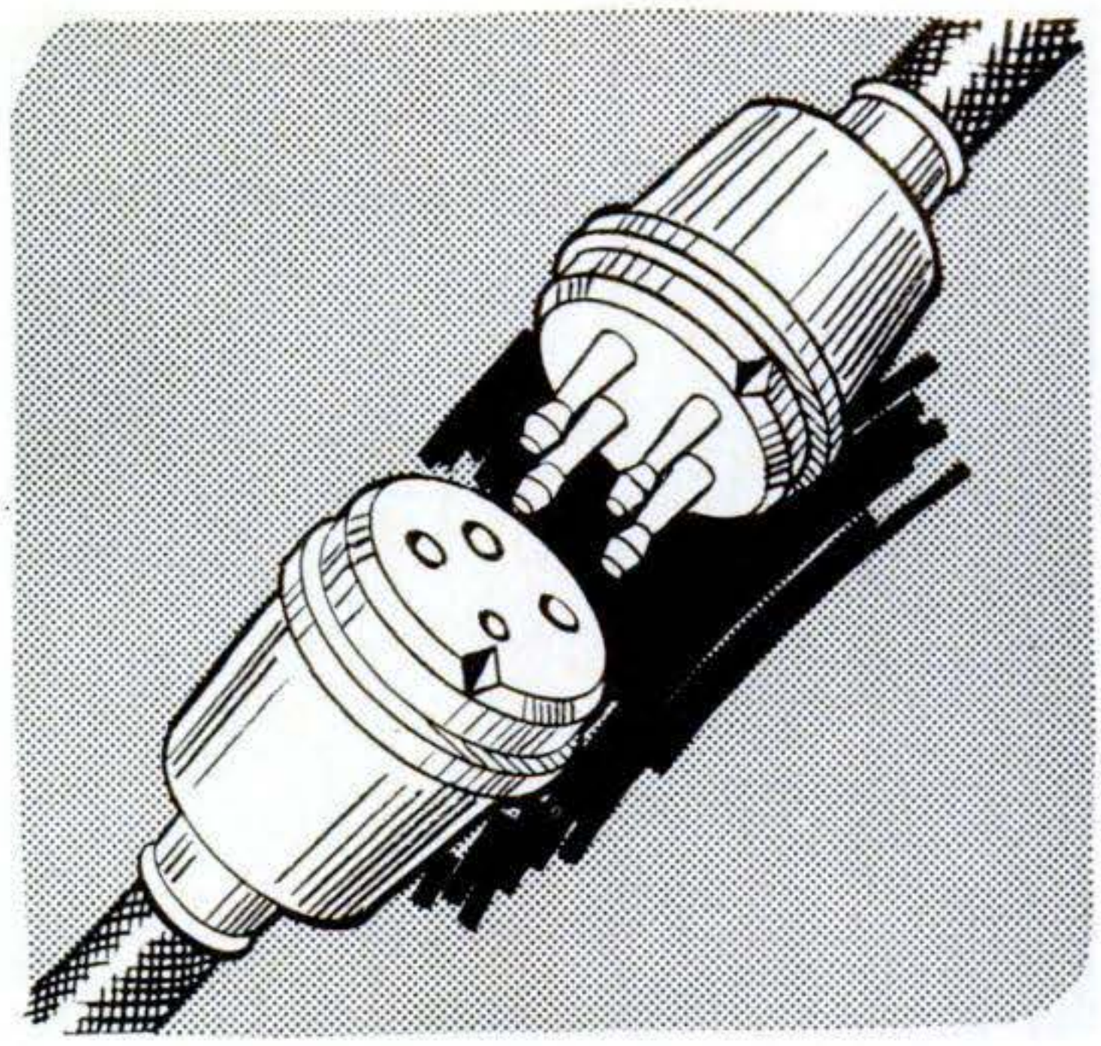
# Hints from the Model Garage

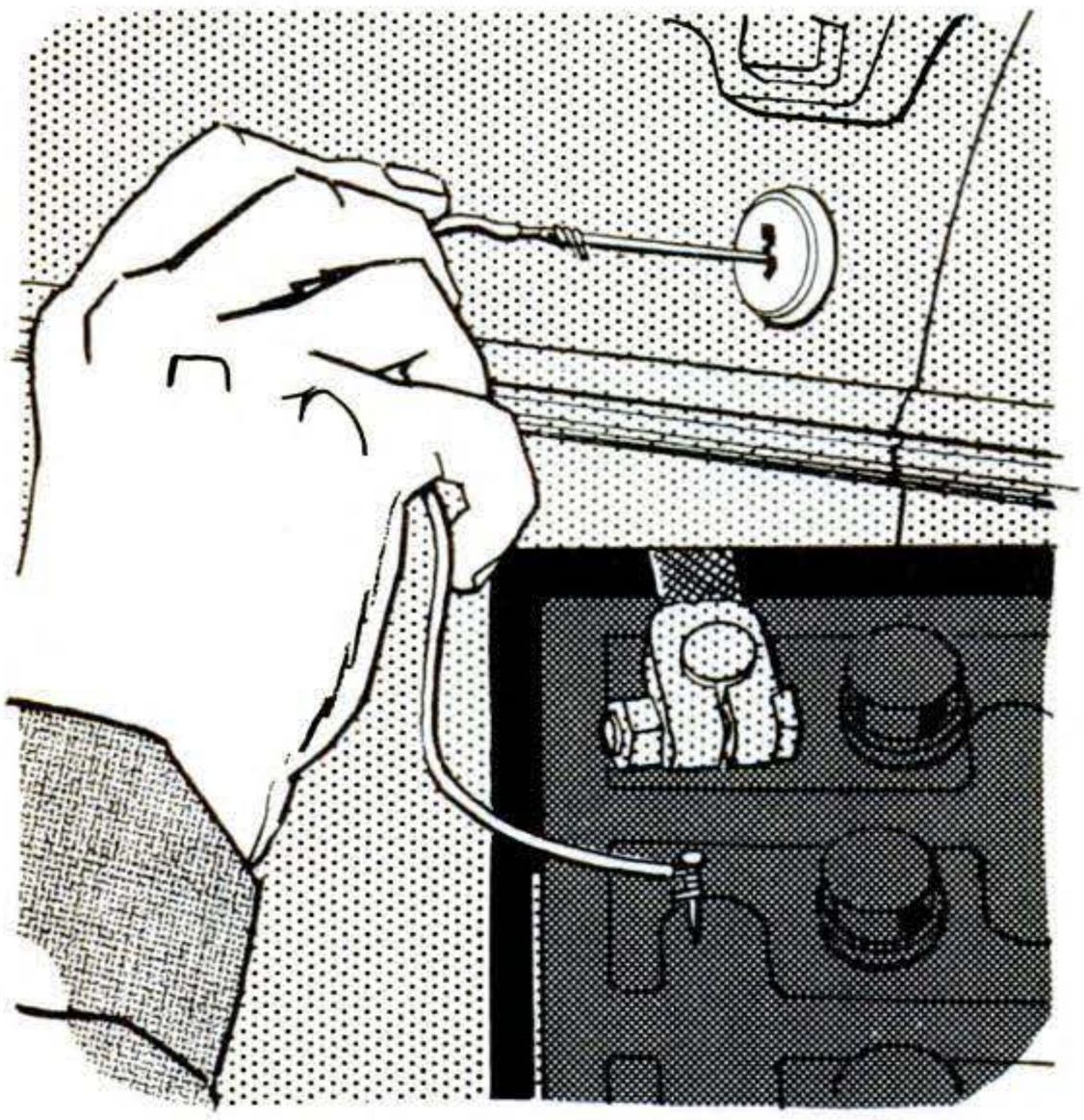
DRAWINGS BY DAN TODD



**To free a stuck heat-control valve** on a Dodge 318 V-8, you don't have to remove the exhaust manifold. Drill and tap a small hole just above the port and use an oilcan to inject a suitable solvent. Work the valve loose by moving the counterweight. Install pipe plug.



**Hooking up a trailer connector** at night can be troublesome. You need an easy way to line up the right pins with the right holes. Cut one notch next to the ground pin and another next to the ground hole, and you can "feel" your way on the darkest night.



**A key broken off** in the door lock? A needle or steel rod hooked to one cell of your battery will remove it. Press it into the lock while grounding another lead for a moment. This welds the broken key to the rod. You can then pull out rod and key with pliers.

**Frequent fuel-pump failure** is usually caused by broken diaphragms. To make a diaphragm last longer, install it this way: Assemble the pump, leaving the screws loose. Operate the arm, and when the diaphragm is stretched fully, tighten the screws.



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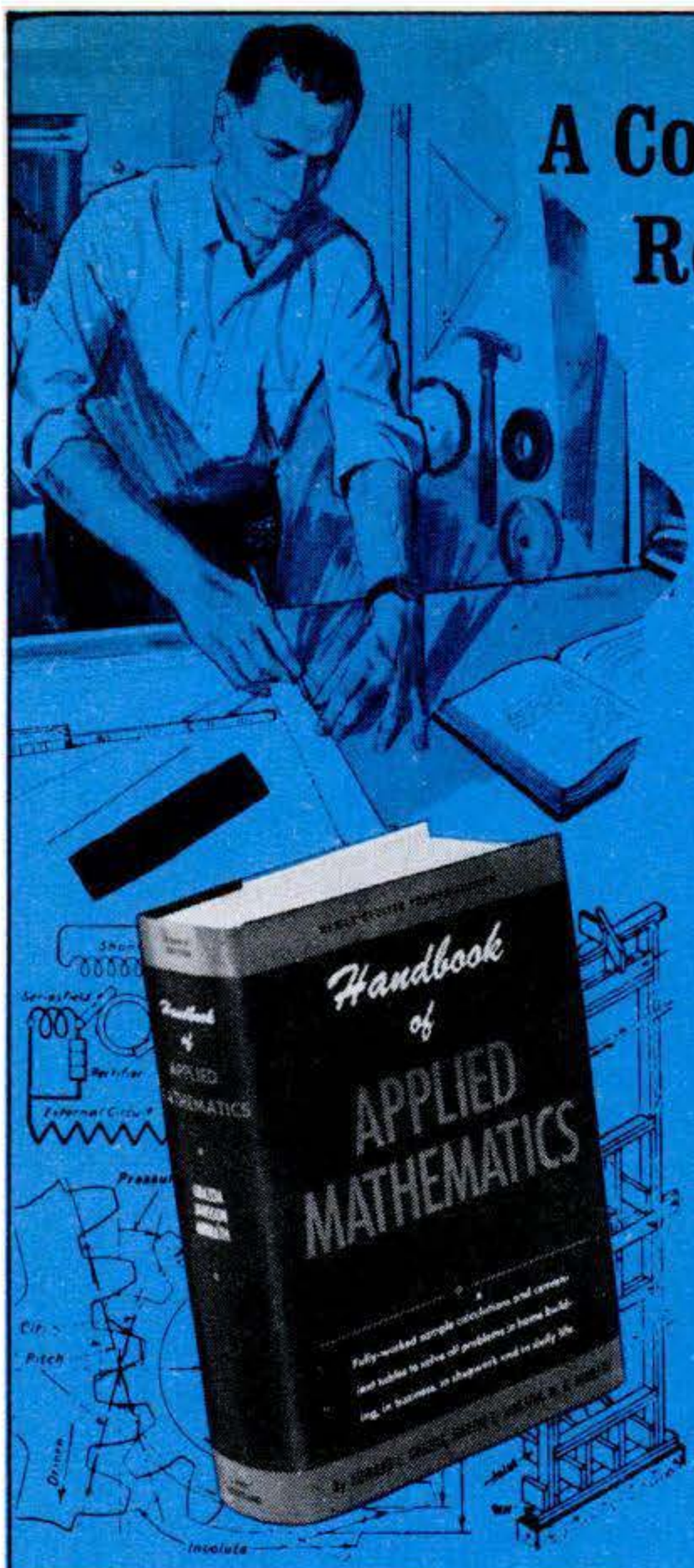


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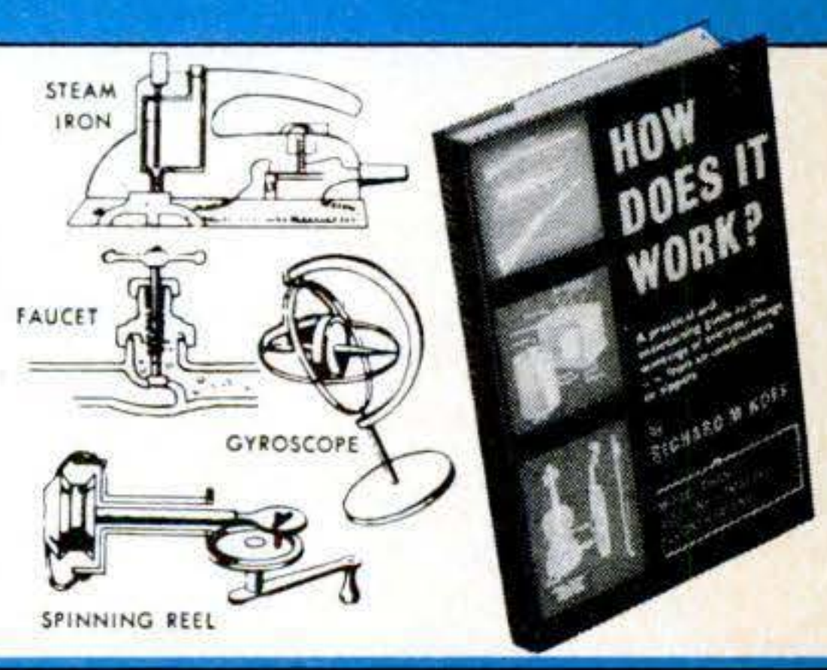


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[Continued from page 185]

be pure extravagance for anybody whose welding needs are as occasional as mine.

Then I stumbled on an ad claiming this Solidox kit for $34.95 postpaid would come all set to fire up with 14-ounce tank of propane, two-pound can of solid oxygen pellets (whatever they might be), some flux-coated brazing rod, dark goggles, and a flint sparker. I bit.

But when it first arrived, I couldn't take it seriously: a pint-size lash-up of sheet brass and tin and tanking, hardboard and rubber tubes, odd nuts and bolts and rivets and corner irons. A mere seven pounds! Only six by 11 by 12 inches!

*This* was supposed to produce a flame that "exceeds 5,000 degrees F. to braze, weld, silver-solder, and melt ¼-inch steel"? That was what the maker, Cleanweld Products Co., Southgate, Calif., claimed. Shrugging, I followed the procedure for firing up:

**Firing up.** Scratch the whitish tip of a pellet on a safety-match folder to set it alight. Lay the smoldering thing on its burner tray and lock the tray in that brass boiler-like affair. Now crack the propane valve, spark the oxy/gas mixture aflame, and shape up just the right white inner feather by fine adjustment of that one valve. To my surprise, it worked!

Those pellets, I found out, are molded from a blend of slow-burning metallic fuels and sodium chlorate; the latter has a lot of oxygen atoms in its molecular makeup. Thus, hissing and orange at 300 degrees F., a lighted pellet glows along at one inch every two minutes, releasing and heat-pressurizing oxygen to flow up and join the propane through a double hose of silicone rubber.

Metallic-salts by-products are left behind in a ceramic filter; traces of moisture are soaked up by alumina pellets.

This is pretty innovational stuff when you consider that, aside from Solidox, the only way oxygen can be packaged for instant use is under terrific compression in heavy, thick-walled steel cylinders that can only be wrestled from job to job by caddy and truck.

I've now used the Solidox outfit often enough and on projects varied enough, to satisfy myself that it can do light welding, medium-to-heavy brazing, and silver-soldering consistently well. The pellets furnish an uninterrupted oxygen flow adequate for most home-size repair or small construction tasks. Only once has the largest (four-inch) pellet and its eight minutes of oxygen failed to carry me through a job.

**Snapout.** I was irritated by the occasional fluctuation of oxygen pressure that would either extend the flame's feather too long and cool, or cone it too short and destructively hot. Once, even, it shortened to a snapout, and my experience at relighting prompts this warning: If you see no flame but hear a hissing roar, you've got intra-torch ignition. Simply shut off the propane and try again.

With its single, simple tip, its limited gas volumes and pressures, the Solidox torch can't be expected to zap out a long white tongue to cut metal or do really heavy-duty welding. And I still can't get over its haphazard and homemade look.

On the other hand, it brings flame welding to men like me who won't pay the big-outfit price. And it offers the pro a handy way to carry metal-marrying heat into tight or faraway spots his big equipment can't reach. PS

## How Safe Is Solid Oxygen?

Solidox is so new that request for UL approval has not yet brought a report, though the propane tank and control valve are UL-approved. Meanwhile, the author and other welding experts consider the torch even safer than standard oxy/gas welding equipment. Hoses are shorter and less exposed to damage. Gas pressures are lower. Excessive buildup in the oxy-generation chamber is impossible because of two soft-plug pop-outs; and a Teflon check ball prevents back-up of propane.

One precaution: Keep on hand a cooling can of some sort for spent Solidox pellets; they may look cool when removed, but can char wooden bench tops or ignite inflammable contents of trash cans. Never drop a hot pellet into water.

Otherwise, observe the same safety rules as with any other open-flame soldering or welding equipment.



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Consider the oil filter.

The better it is, the more it filters.
And the faster it chokes itself to death. Arrrgh!

In just a few short months (or miles)
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and starts down the road to suicide.

That means every time you get an oil change,
you're sort of stuck for a new Fram filter. But then,
it sure beats getting stuck for a whole new car.

Amen.

Fram Corporation, Providence, Rhode Island 02916

[Continued from page 89]

### Are X-ray and ultraviolet treatments any good?

Ultraviolet treatment in small doses once or twice weekly causes the skin to peel and opens plugged glands. Dermatologists consider it of more benefit in treating acne on the chest and back than on the face. With the more widespread use of antibiotics and other drugs for treatment, the need for X-ray therapy has been sharply reduced, but not eliminated. It is reserved for severe cases.

### What are the chances of permanent scarring?

With modern drugs and treatments, dermatologists estimate that the chance of serious scarring from acne is only about one in 100, and this is being cut down with new advances. The best way to avoid scarring is to treat acne when it starts and keep at it until it clears up. Acne is not to be shrugged off with "I'll wash my face" or "I'll grow out of it." It is a disease; scarring is the price for letting it go.

### Can acne scars be removed?

For badly scarred patients, sandpapering and surgical planing can be effective. They must be done by a specialist. One technique is "dermal abrasion." A motorized wire brush or wheel scrapes the skin. When a new surface layer grows again in a few weeks, many of the pits and holes fill in. It is effective in about four of five cases, although some patients may require two or three treatments, spaced weeks or even months apart.

### What effects do food and drink have?

Certain foods appear to aggravate acne. Among these are chocolate, and foods containing it; nuts, including peanut butter; seafood, particularly tuna fish and shellfish; large amounts of dairy products; foods containing tomatoes, fried dishes; sweets; spicy foods.

Dr. Jerome K. Fisher told a recent Congress of the American Dermatological Assn. that, in a study of 1,088 acne patients, he found milk a principal villain. Some of his younger patients drank as much as four quarts a day. Their acne tapered off as soon as they cut down on milk. Dr. Fisher blames the high concentration of salt, butterfat, and milk sugar.

Not all sweets are bad, according to recent studies. Reasonable amounts of hard candies, lemon drops, licorice, and mints bring few apparent reactions.

Iodine, found in shellfish and iodized salt, should be avoided. It makes the sebaceous glands produce more clogging oil. Eating too much cream cheese is harmful. Potato chips, French-fried potatoes, and salted peanuts, because of their oily nature, are particularly bad. The typical teen-age lunch of a hamburger or cheeseburger (the meat has a fat content of 25 to 35 percent) and a milk shake is especially productive of acne outbreaks. Some soft drinks, particularly those with high sugar content, have a tendency to cause acne to flare up.

However, many of the drinks that are merely carbonated and contain a little fruit flavor are not thought to be important in causing acne, according to certain medical authorities.

### How important are fresh air, sunshine, and exercise?

Anything conducive to good health in general is helpful here, too. And that includes getting enough sleep. A moderate suntan is usually beneficial. It causes drying and peeling, which can open clogged pores. Too much sun, though, can increase the activity of the skin's oil glands.

Plenty of exercise is fine, but excessive sweating or wearing tightly fitting clothing or athletic equipment will make matters worse.

"The most important treatments for acne are explanation and understanding," says Dr. J. Roswell Gallagher, a top authority on teen-age medicine, of the Yale-New Haven Medical Center. "Each case is an individual problem. What is right for all, though, is the elimination of erroneous ideas about the causes of acne that produce such enormous anxieties. No disease is so misunderstood or surrounded by so many old wives' tales. The more these can be dispelled to stop those with acne from being embarrassed, worried, or conscience-stricken, the fewer lasting problems there will be." PS



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## Two Designs for Saw-Table Extensions

[Continued from page 170]

The rest of the job is fairly straightforward. But do an accurate job of drilling the holes for the roller axles. Best bet here is to drill a 1/4″ hole, but make the slot 5/16″ so the rollers will turn freely.

**The flip-down version.** The length of the extension table must be related to the distance from the saw-table surface to the floor if the table is to store out of the way. Since this imposes limitations, a slide was incorporated in the design. Thus, with one table attached on each side of the main saw table, you can achieve a total work support of close to 13′ without sacrificing the space-saving advantage.

Start off by shaping the guides, and the block that attaches to the saw table. Next, cut the slides, using the dimensions in the drawing but dressing just enough so the slides will move freely in the guide grooves. Attach the guides to the block by using 3″ T hinges, and set this assembly on a flat surface.

Cut the extension table to size and use clamps to make a temporary table-slide assembly. Put this in place on the guides and adjust until you are sure the extension table will move freely. Make the assembly permanent by using 1½″ No. 8 flathead wood screws. Locate the extension table so its forward edge lines up with the forward edge of the saw table.

Cut and attach the cleat to the outboard end of the inner slides. This can be done with screws or with glue and nails. Then make the leg assembly, adjusting the height to match the distance from the saw-table surface to the floor. Attach to the cleat with 1½″ butt hinges.

Hold the block to the saw table with clamps and drill for, and drive home, the 2″ No. 12 screws that secure it.

To get the most from this project, it's a good idea to sand all parts thoroughly before assembly. Brush on a coat of resin sealer after assembly and, when dry, polish with OO steel wool. Finally, apply a generous coat of Butcher's wax and rub down. For best results, repeat the waxing operation.

If radial-saw mobility is important in your shop, the extension table can be fitted with brake-type casters to retain this flexibility. The flip-down version does not require them. PS

## The Safe Paints to Use Around Children

[Continued from page 147]

- Not all the colors of a given "label" of a given manufacturer may be safe, even though some colors are.

**Guidelines to safety.** First of all, never use a paint intended for outdoor use in children's rooms. Lead content of exterior paints may be high, and they may also contain fungicides, antimildew ingredients, and other toxic materials.

Second, give the nod to latex paints whenever all other factors are equal, since there is less likelihood of toxicity. It is among latex paints that you find specific "safe-for-children" labeling.

Third, not all manufacturers are willing to stick their necks out with "safe" labels. There are sound reasons for this. Suppose a paint maker has a nontoxic product, and says so on the label. Somewhere a consumer buys a can—and puts it over an old paint that is toxic. The baby chews through both coats and becomes ill. The consumer blames the new paint he used—not the old coat underneath it.

Fourth, use your head. One of the leading custom-color outfits, Colorizer, has a very interesting label. It says that the paint is nontoxic unless it contains pigments numbered 1, 12, 53, 56, 57, or 71 in the system. In other words, the tinting base used is okay; certain pigments make the paint not okay.

Fifth, consider most clear finishes safe, since they contain no pigments.

Sixth, remove old peeling, flaking, blistered paint from windowsills, woodwork, and furniture.

Since it takes a quantity of lead and some other substances to cause illness, be alert to the following points:

- Don't let a thick coating of paint build up, particularly on window sills and shelves, which offer edges to chew on. Before repainting, sand all accessible edges down to bare wood.
- If you use a primer other than the paint itself, check it for toxicity, because it might be eaten, too. Otherwise, don't use a primer.
- When refinishing children's furniture, or toys, don't just overcoat a previous paint—particularly if the item is secondhand. You can't be sure of an unknown finish. Strip it off with a paint remover and start from scratch. PS



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## Your Automatic Transmission

[Continued from page 81]

cylinder and the shaft, and shifts are made in the proper pattern. A complete repair is, of course, a bench job, but this is one you can put off without risk of damaging other parts.

Late upshifts *when the engine is hot* are caused either by faulty throttle-pressure adjustment or by a dirty or sticking governor. These are small matters, easily fixed on the car. To remove the governor, it's necessary to disconnect the drive shaft, but that's a quick job, too.

**No downshift on kickdown.** This is a very common fault, even in new cars. In our PS road tests, for instance, some of the test cars fail to downshift in the 25-70 m.p.h. acceleration test. Many car owners are unaware of the problem, because when they step on the gas to accelerate, the torque converter compensates for the lack of a downshift, and the car does in fact speed up.

To simulate this malfunction, Mike turned on high clutch pressure to work against the shifter valve in the control unit. This kept the front clutch from disengaging and prevented the downshift. By adjusting his faucets, Mike could hold the downshift to low range to any speed, from 22 m.p.h. to what seemed practically a standstill.

What do you do if you're a performance-oriented driver and unwilling to put up with any sluggishness in your car? First, you check the throttle-pressure adjustment. That's a simple check, under the hood or at the side of the transmission. If that doesn't turn up the trouble, it's either a sticking governor or a sticking shift valve. Both of these can be worked on with the transmission in the car.

If you have a minor transmission defect and do not have it corrected, the chances are that it will deteriorate. Instead of a simple five-dollar adjustment, you may end up with a nightmare of a bill.

Analyze your symptoms and make your own diagnosis. Explain your theory to a transmission expert and then have him test-drive your car. If you agree on what's wrong, there should be no problem. If you disagree, wouldn't it be great if you were right and he was wrong? PS

## Cheap Power from Underground Steam

[Continued from page 85]

geochemistry, and temperature by means of thermocouples in exploratory wells.

Cartwright Aerial Surveys, Sacramento, Calif., is mapping hot spots with airborne infrared scanners, magnetometers, and gamma-ray spectrometers. Farther aloft and in the future, infrared scanners on EROS (Earth Resources Observation Satellite) will detect, among other things, geothermal resources.

One day, underground nuclear blasts may be used to trigger geothermal gushers at promising sites.

**Underwater steam.** Curiously, geothermal steam may help conquer the ocean frontier. Hot spots may be as common under the sea as on dry land, says research geologist Dr. Carl F. Austin, of the U.S. Naval Weapons Center, China Lake, Calif. He predicts that undersea steam wells could yield electricity, drinking water, and oxygen (by electrolysis) for vast sea-floor colonies and secret submarine bases.

**Steam on the moon?** Geothermal energy's strangest frontier, however, is in outer space. Scientists pondering the economics of space travel feel any hot spots on the moon or planets would cut astronauts' travel expenses considerably.

Contrary to popular notion, the moon is not a burnt-out ember. Infrared scans have shown hundreds of hot spots. Says Navy Capt. Lee R. Scherer: "We know without question there's volcanic activity on the moon."

To harness a gas vent, Dr. Austin suggests, spacemen could ram a plastic tube down its throat and cement it in place. "Then they'd be in the gas and power business," he says. If steam does issue from lunar magma it would solve a lot of problems. It could be condensed for growing plants. Electrolysis would yield oxygen and hydrogen to fuel rockets.

Meanwhile, back on earth, experts such as James B. Koenig of the California Division of Mines and Geology, foresee, from the cheap energy made by the tremendous boiler beneath our feet, the use of power on a scale now only dreamed of: to cool our homes, heat immense greenhouses, desalt seawater, and spin industrial wheels—and at a low, low price. PS



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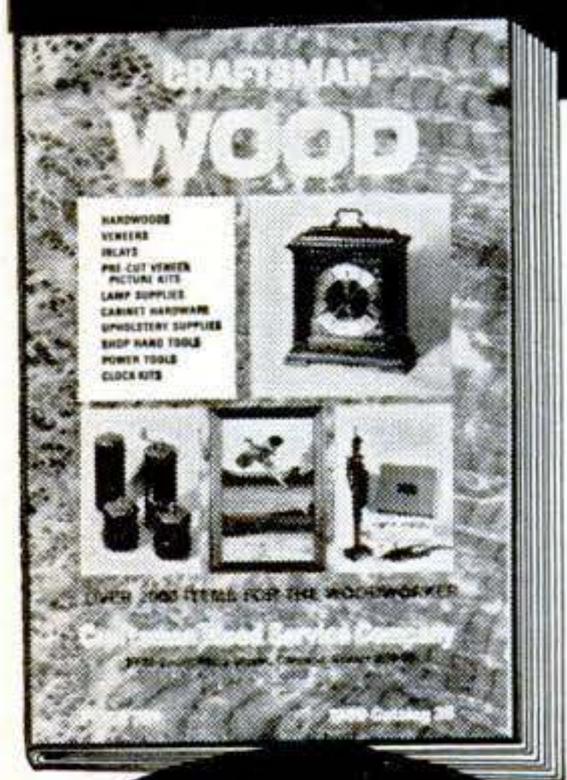


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## Before You Buy a Snow Thrower

[*Continued from page 167*]

maker, Ariens, provides three—a main clutch that cuts all power to all drives, an auger clutch, and a wheel clutch of the squeeze type on the handgrip. The squeeze grip differs from the gated or detent-lever type, which requires a positive movement to engage or disengage. In use, the squeeze clutch is handy for inching a thrower into a drift or into a parking spot in the family garage.

The second, or auger clutch, found on nearly all the better machines, is necessary for starting, permits freeing the chute of foreign objects, and allows transport or garaging without accidentally gnawing up the car or stored lawn furniture. Incidentally, Jacobsen has given thought to the hazard of unthinking operators plunging a hand down the throat of the chute to clear it. Their new models have a flexible plastic flap that flexes for snow discharge but folds back to block the chute when no snow is actually coming through.

**Power reverse.** In general, the handiest drive clutch and the most accessible gear shift and throttle make for the easiest-to-handle snow thrower. On any of the heavier machines, a power reverse is essential for backing up slopes, rocking in and out of drifts, and backtracking. Although not the most efficient way of removing snow in terms of geometrical coverage, backing and going forward is often the most pleasant way to work since you can keep your back to the wind. Make sure your snow thrower can be flipped in and out of reverse instantly.

Do not expect to find power reverse, multiple speeds forward, or fancy gear trains on the lower-cost, single-stage machines with an 18- or 20-inch cut. For the most part, these features are not needed within the practical-use capabilities of the thrower. Actually, the performance of some of these, such as the Hahn-Eclipse, four-hp., 20-inch unit and the Toro Snow Hound 20, is excellent for average sidewalk and driveway use.

There are details of quality, however, that are all-important. Snow removal is brutal work for even a six- or seven-hp. machine. The name-brand manufacturers of snow removers, garden tractors, tillers, and mowers know and under-

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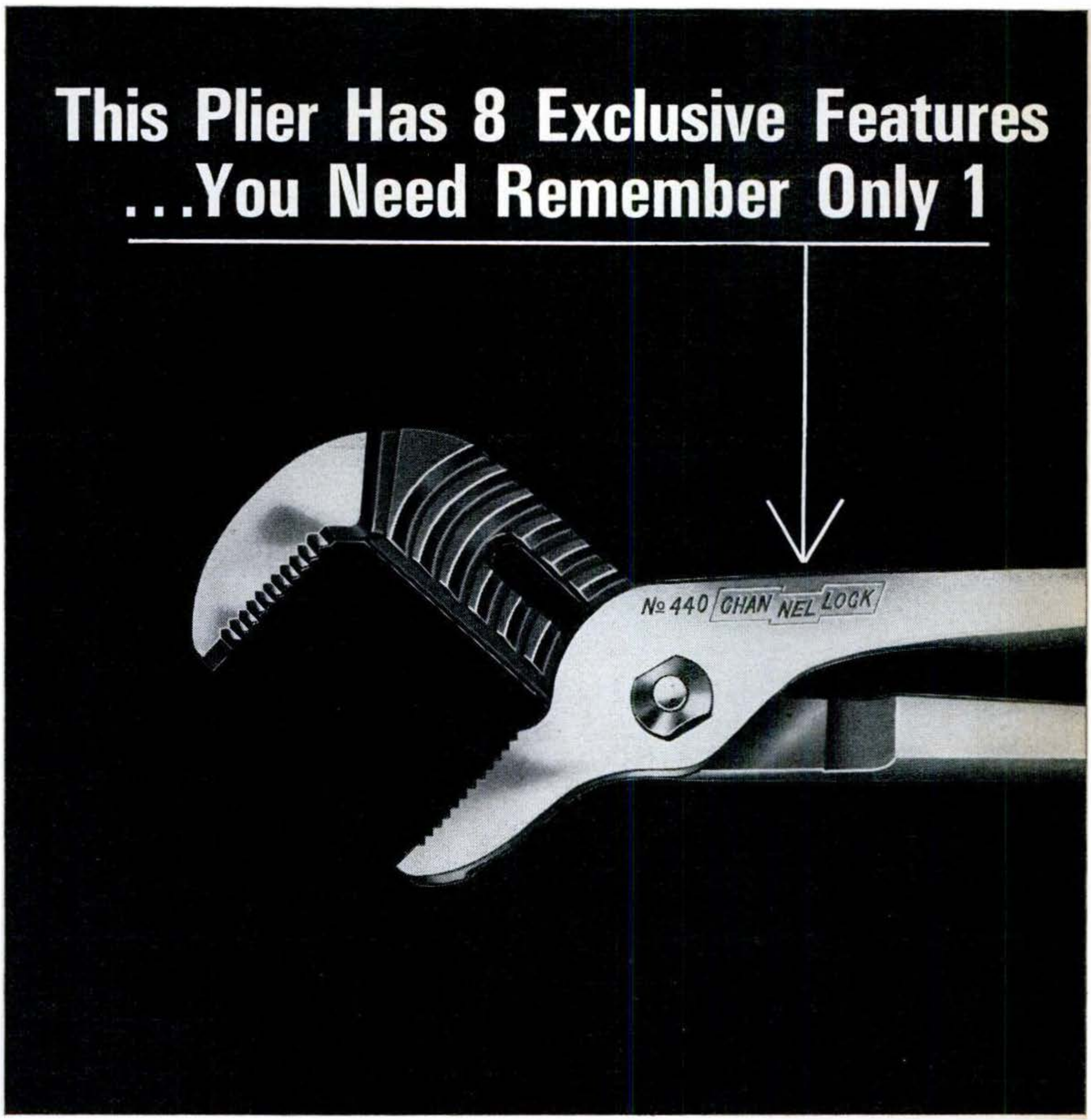


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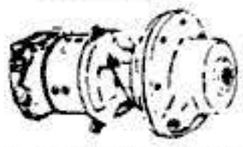

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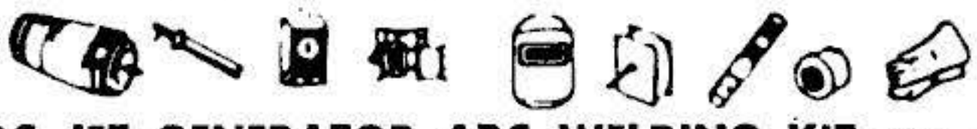

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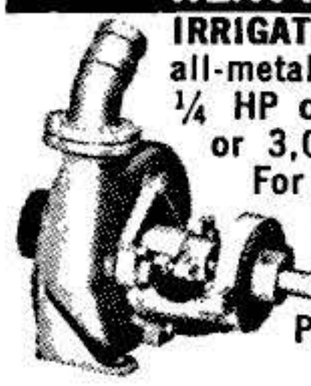

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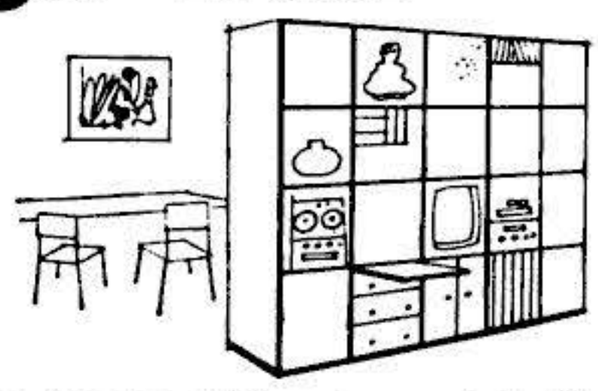

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**Before You Buy a Snow Thrower**

stand the engineering requirements and all try to provide a level of quality that may be overlooked in off-brand throwers.

Without playing favorites, a look at the Wheel Horse Trailblazer 7 reveals some typical built-in good points not apparent to the casual shopper. The rotor is 11-gauge steel. Bearings are sealed and positioned to maintain rigid alignment of the drive train. Shear pins protect against hidden-object damage (Hahn-Eclipse uses a shock-absorbing clutch). Rotor drive is through a heavy steel worm gear and bronze ring gear.

The differential allows easy steering but locks up for traction under tough going. Gears are hardened, not cast pot metal. The transmission is all gear, machined for center tooth contact, and sealed. Ball bearings, not sintered-iron bushings, are used throughout. Even the tubular handles are beefed up with smaller tubing slipped into the critical points before bending.

A similar list could be made for most of the other leaders in the field, and these are the differences between years of solid use and disappointment.

**The riders.** Something new has been added in this category with the introduction of a 36-inch snow-removal blade for the International Cadet 60 and Bolen's Lawn and Estate Keeper riding mowers. Although such mowers (less cutter decks) may not be absolutely ideal snow machines from the standpoint of winterizing and other details, it certainly makes sense to use them as power packages for snow removal within practical capabilities. It figures that a husky riding mower with a suitable blade out front and coupled to the deck lift linkage will likely handle about 90 percent of the light snow-removal jobs on most sidewalks.

If you already have a tractor when you start shopping for a snow-thrower unit, you must more or less accept the one offered by your tractor maker since it will have the proper mounting details and drive connections. Thus, when buying a tractor, it pays to think beyond grass-cutting if you live in the snow belt. The differences in tractor-driven snow throwers center around:

• Transmissions and forward speeds. Hydrostatics do a top job here, but others

*Continued*



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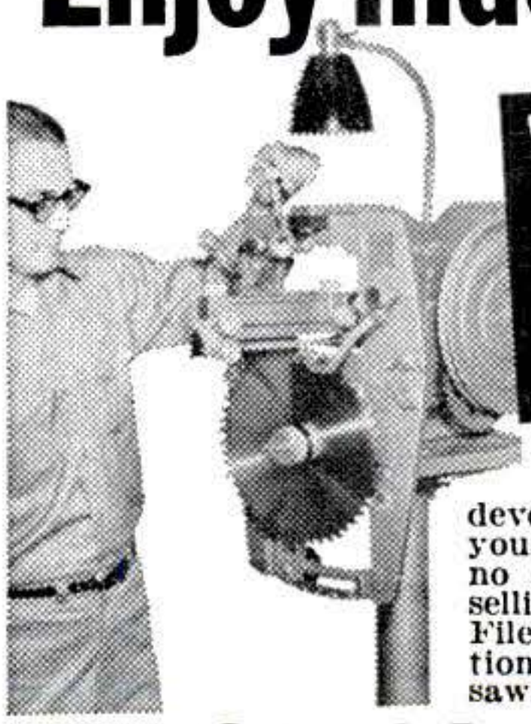

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**Before You Buy a Snow Thrower** such as the new Ariens seven-hp. lawn tractor with six forward speeds will probably match them.

• Differentials with locking features to avoid wheelspin, or separate wheel brakes as on the Gravely 424.

• Thrower drive connections. These, like the two-stage and single-stage concepts, are subject to personal evaluation. The users of belt drives are strongly loyal and the users of solid splined shafts are also adamant. From the standpoint of appearance and mechanical clutter, the shaft drive running from a front power takeoff is the cleanest and offers practically no hazard.

• Thrower lift method. These may be spring-balanced manual levers, hydraulic or electric. Try before you buy. A bad lift linkage can be a back wracker.

• Ease of mounting. The better thrower attachments are latched to existing mounts, and the power drive and lift couple up in minutes without need for wrenches. Avoid tractors that take snow-thrower kits with lots of bolts, etc.

**Incidental features.** Headlights can be very important if you're working around drives and road entrances subject to traffic. Weather shelters that enclose the cab are available and are hard to class as luxuries in tough winter weather. No tires, winter cleats or not, do a really good job on glare ice; get wheel chains.

With wheel chains, unless your area is subject to repeated heavy snows, you may not need a snow thrower at all. Big garden tractors, and even six- or seven-hp. lawn tractors, have plenty of power to push ordinary snows off drives and walks with a blade. The difficulty with a blade arises only when one snow follows another and the plowed snow freezes in hard banks at the edges of the cleared area. When this happens, it's sometimes hard to find a place to push the snow. If you choose a blade, look for quick, easy, and *very solid* mounting running back to the rear axle area. Blades are heavy and the lift mechanism must be good to avoid back strain. Also, you'll find it important to be able to angle the blade right, left, or squared away. Well-designed dozer blades have controls that enable you to perform such adjustments without stopping or leaving your seat. PS



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## Our First Manned Saturn V Shoot

[Continued from page 100]

desirably imposes an extra, fluctuating fraction-of-a-g load on the vehicle and crew. (Sitting atop the long Saturn V stack, the relatively light spacecraft is subjected to even higher Pogo-vibration loads than the engines at the other end that cause the problem.)

The Pogo team's solution: Detune the two frequencies by placing a pneumatic shock absorber in the liquid-oxygen line of each of the five F-1 engines.

Cavities in the engines' lox prevalves make this easy. Just fill them with helium gas—which doesn't condense at liquid-oxygen temperatures—and you have the desired shock absorbers. The first stage's ample supply of helium for pressurizing the fuel tank can be tapped to do it. Thus the Pogo fix was made.

Both a first stage with this shock-absorber modification, and a second stage with the new igniter fuel lines, were successfully test-fired last August at the Marshall center's Mississippi Test Facility. The two simple fixes qualify the Saturn V for manned flight.

**New plans.** Called Apollo 8, the first manned Saturn V flight will follow the initial manned Apollo mission, boosted by an Uprated Saturn I—Apollo 7, due to have taken place when this is read.

Apollo 8, likewise, will carry the Command and Service Module (CSM); contrary to earlier plan, it will not include the Lunar Module, whose debugging is taking longer than expected. Plans for the first manned Saturn V, and later missions, had therefore to be revised.

Apollo 8's new basic mission plan provides operations with the manned CSM in low earth orbit—and, after separation of the CSM, an unmanned orbital launch of the Saturn V's third stage into an escape trajectory possibly grazing the moon. However, if Apollo 7 has gone very well, possible options are under consideration for the Saturn V. It might launch the CSM several thousand miles into space. There is even a remote possibility of a spectacular swing around the moon by the manned spacecraft. That a mission as bold as the last is even considered, for the first Saturn V to be manned, bespeaks planners' confidence that all about it has been set aright. PS


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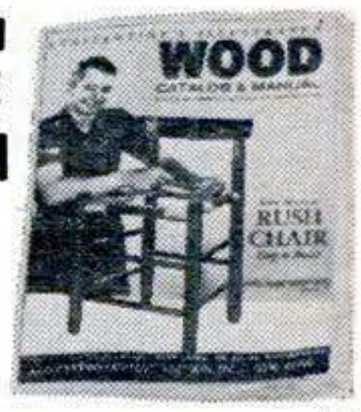


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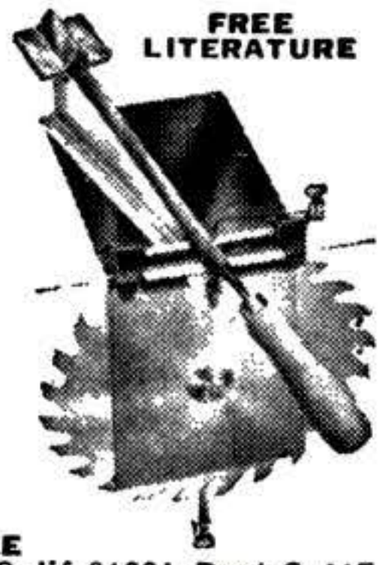

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## AUTEC: Our Secret Undersea Test Range

[Continued from page 97]

### How range tracks weapon and target

A range that tracks speeding objects both through water and air has to be something decidedly out of the ordinary. William Gordy, an RCA test official in the sports-shirt uniform of an AUTEC civilian, told me how it's done:

The Weapons Range comprises air-tracking and underwater-tracking areas, each equipped to record objects' second-by-second positions in three dimensions.

Tracking sites at opposite ends of the air-tracking area use radar; an infrared system that helps radar latch onto a missile; and a TV system. In-between stations employ cine-theodolites, which make telescopic photos imprinted with azimuth, elevation, and time. Their film is processed at Site 1, readings go on punched cards for a computer, and what comes out is the post-test data.

Radar tracking, while less precise than optical, is independent of weather or darkness and gives an immediate one-station finding of a missile's position. Its data go directly into the computer as the chase proceeds.

Telemetry receivers at air-tracking stations also report what's happening within a flying missile. Sensors and a transponder on the weapon transmit pressures, temperatures, vibration data—the whole story of the flight.

When a weapon hits the water, the underwater-tracking system takes over. What follows is a conversation in which weapon and target both tell the shore what they're doing.

### Ears in the deep

On the bottom, in 6,000 feet of water, are some 48 hydrophones—microphones that can stand the water pressure. Cables lead from them to junction boxes called "dolphins" and thence to Sites 3 and 4. (There is another smaller hydrophone array at uprange Site 7.)

Seven hydrophones—six at the corners of a hexagon, and one in the middle—make up a tracking unit. For continuous tracking as an object passes through the field, each tracking unit shares two hydrophones with the next unit.

The object to be tracked—say, a torpedo—carries a pinger. This is simply a

transducer that says "Ping!" twice a second. The hydrophones hear the pings and transmit them to the computer, via land sites and microwaves. They also hear and transmit target pings.

Knowing when a ping was emitted, the velocity of sound in water, and when the ping reached each of three hydrophones at known locations, the computer can tell the position of the object in a flash. "Ping!" Another reading. "Ping!" Another. And so on. As Bill Gordy sums it all up:

"We might start from the Site 7 array; launch through the air, tracking with theodolites and radar; impact in the five-by-12½-mile range where the target is; let the weapon run through there at the target; and collect data on both weapon and target. With all systems time-tagged together, we'd have a complete history of how that weapon performed."

## Acoustic and Sonar Ranges

Sounds that subs and surface ships make when they move through the sea will soon be registered by AUTEC's Acoustics Range. Hydrophones, attached at varying depths to a cable rising from the bottom, will transmit the squawks and squeaks of a passing vessel to Command Control for analysis. The tests should help reduce ships' sounds in building programs. The Sonar Range will check the accuracy of a ship's own sonar and fire-control systems.

These additions will complete a proving ground that is already playing a key role in advancing the technique of anti-submarine warfare. PS

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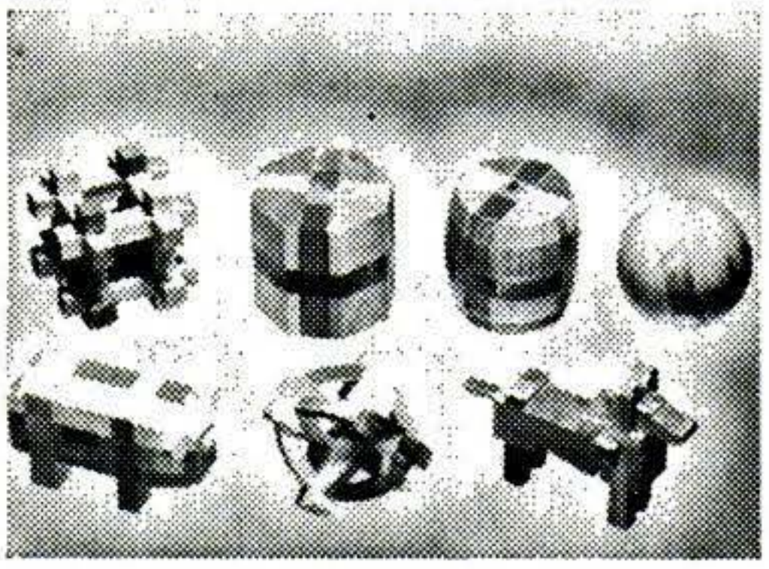

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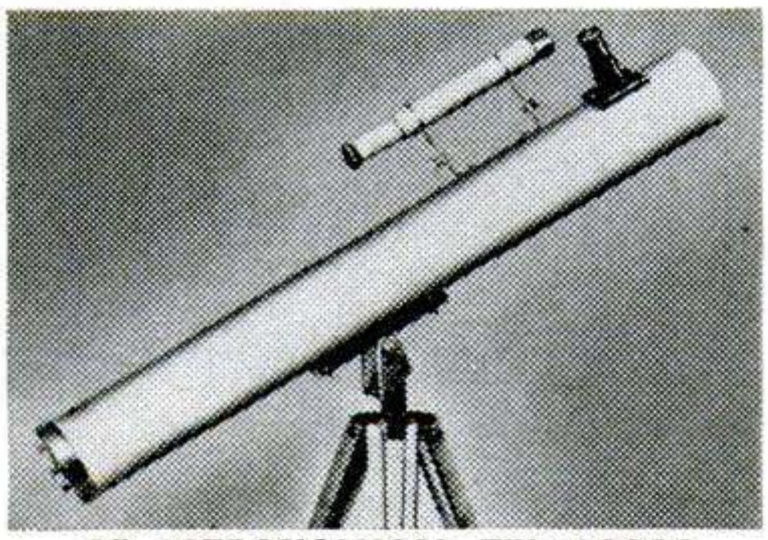

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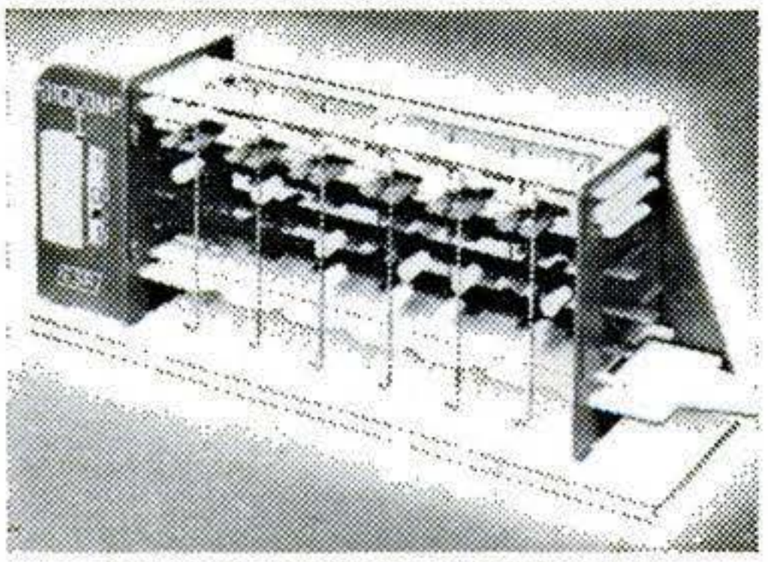

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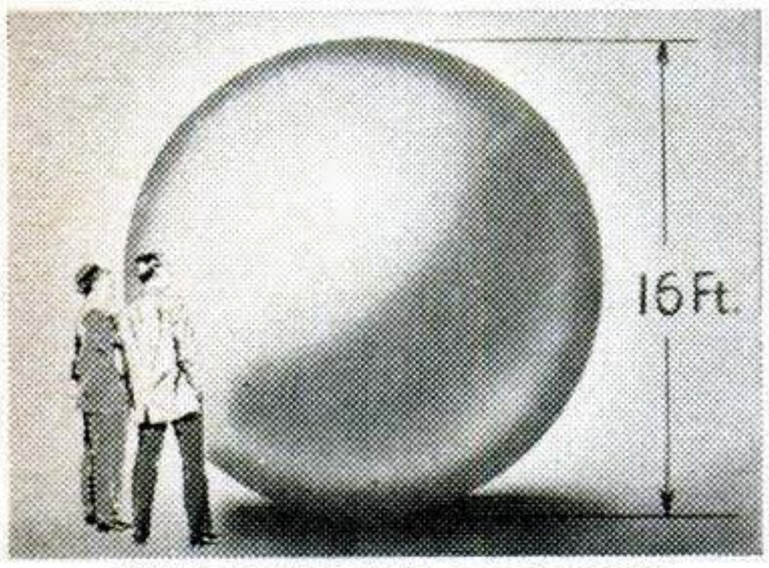


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- Cars with automatic transmissions function efficiently only if the fluid pressures are correctly maintained and since manufacturer's instructions always refer to RPM the Model BT-162 (or an equivalent tachometer) is required to properly service automatic transmissions. Incidentally, the 5,000 RPM maximum range of the Model BT-162 is adequate for all car engines without any exceptions.

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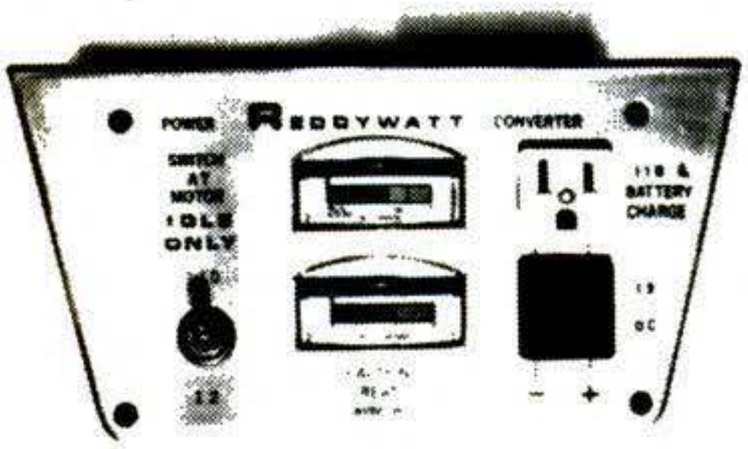
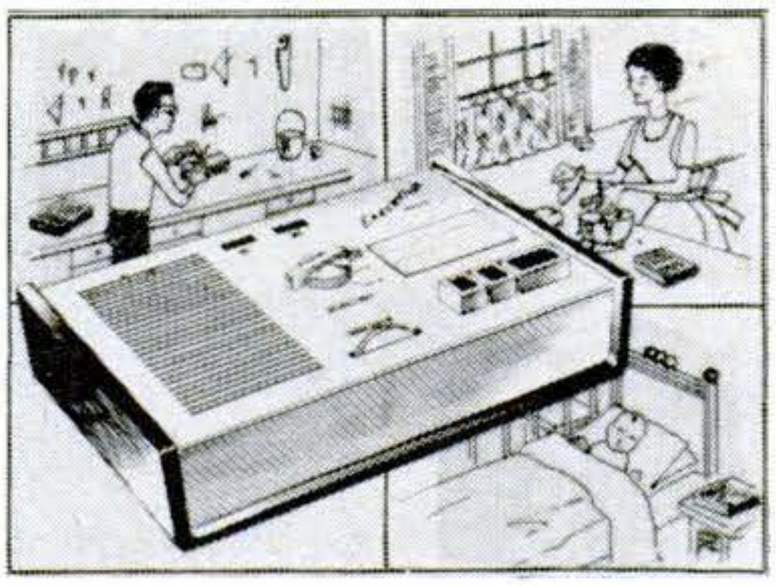



### *110 V. POWER—$49.50*

Campers—construction—Boats, etc. Operate 110 v. power tools up to 1½ HP. Provide electric lighting to 1500 watts. Charge 6-12-24 v. batteries at rates to 50 amp. Reddywatt converter connects in minutes to provide 110 v. power in your vehicle or boat. Connects with your present vehicle electrical system. Panel size 8"x4"x2". Satisfaction guar. or money back. Shipped prepaid—$49.50 ea. Esse Radio Co., Dept. PS11, 368 S. Meridian St., Indianapolis, Ind. 46225.

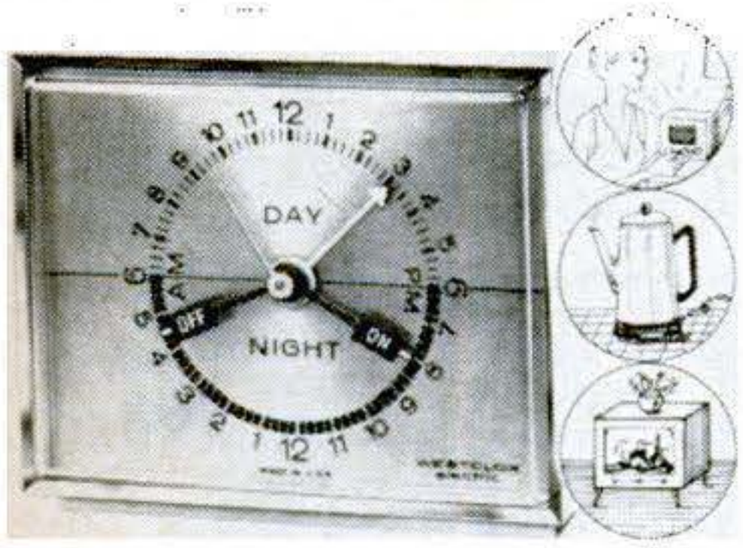


### *3 CHANNEL WIRELESS INTERCOMS*

New solid state intercoms require no interconnecting wires or special installation. Plugs into AC outlet, no batteries nec. Intercoms operate between adjacent buildings on same power line. Contoured walnut wood case & satin-gold panel. Each unit is a Master with a 3-channel feature allowing Master-to-Master or Master-to-Remote operation. Special: 2 Masters for $49.95 p.p., or 3 for $69.95 p.p. Send check or M.O. to Al Con, Box 1348B, Lawrence, Mass. 01843.

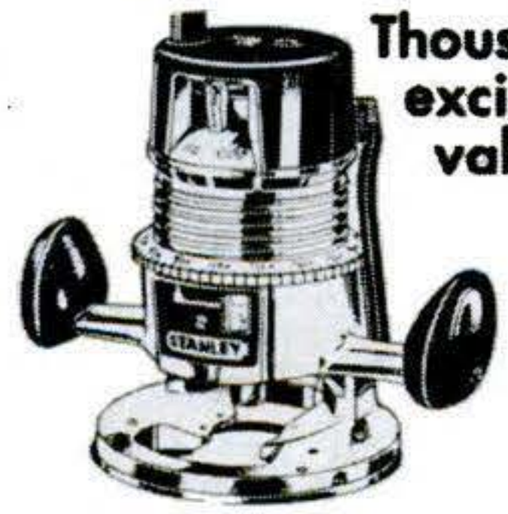
### *SURPLUS RADIATION COUNTERS—$9.99*

Postpaid. Fraction of Government Cost. Civil Defense radiac equipment utilizing three ranges of 5, 50 and 500 roentgens per hr. Measures X-rays, beta rays and gamma rays. Batteries required are one "D" flashlight and two Eveready #412 easily obtainable. Good used units only $9.99 each postpaid. Brand new units only $19.95 each postpaid. Esse Radio Co., Dept. PS11, 368 S. Meridian St., Indianapolis, Ind. 46225.




### *24-HR. CLOCK & SWITCH TIMER*

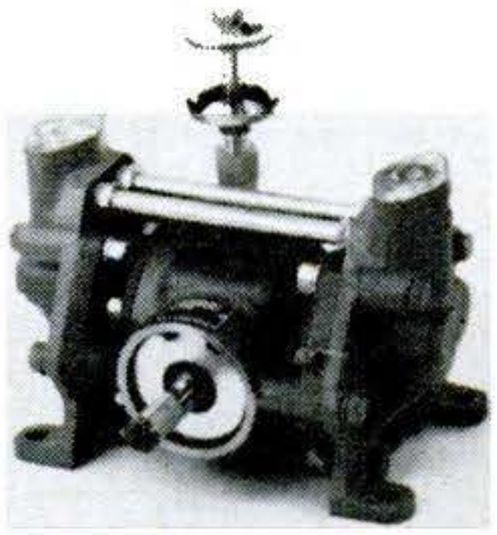
Electric switch timer turns lamps or appliances "ON" or "OFF". Automatically turns lights "ON" when you're gone to discourage burglars. Easy to use, just plug lamp or appliance into timer and set it. Repeats every 24-hr. cycle or manual at your option. Large Day-Night periods on dial has sweep hand. Handsome wood tone case also usable as a clock. Shatterproof lens. U.L. $9.95 p.p. with check or M.O. Al Con, Box 1348G, Lawrence, Mass. 01843.




**Thousands of exciting tool values!**

### *SILVO (BRAND NAME) TOOL CATALOG*

Thousands of Exciting Tool Values! Stanley, Millers Falls, Skil, Thor, Wen, Disston, Wiss Wellsaw, Dremel, Speedy Sprayers, Plumb, Huot, Kennedy, Channellock, Porter-Cable, Rockwell, Helios, Vise-Grip, Crescent, Ridgid and many other Nationally Advertised brands of Tools & Supplies. We ship Coast to Coast at prices Hard to Beat. Send 25c for our big 148-page tool catalog today. Silvo Hardware Co., PSD-11, 107 Walnut St., Philadelphia, Pa. 19106.

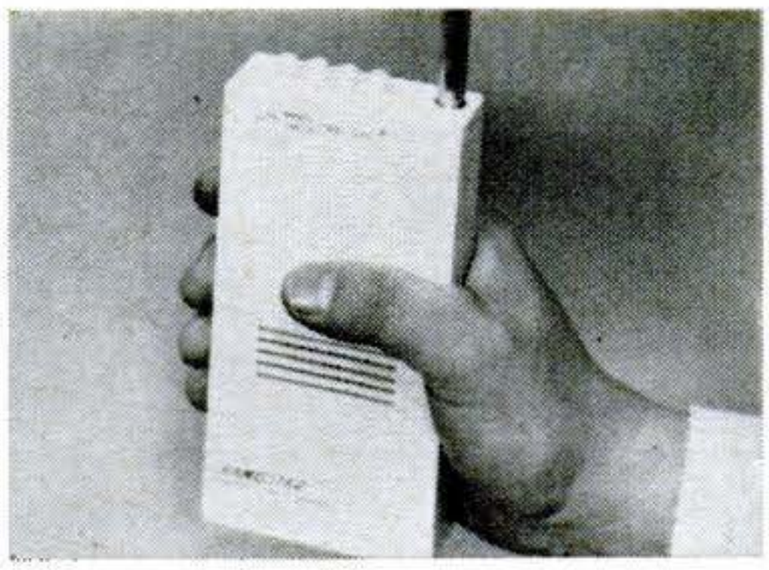


### *CAR WASH 500 PSI PUMP—$39.50*

3GPM Weatherhead mfgd. Positive displacement, hydraulic actuated diaphragm pump. Pumps chemicals such as solvents & weed sprays. Internal by-pass valve set around 500 PSI allows interception of flow without harm to pump. Operates from 1 HP electric or 2½ HP gasoline motor. Less power if connected for lower pressures. ⅝" keyway slotted shaft, 2" long. 9½x6½x7½ overall. Brand New! Ship. wt. 21½ lbs. Esse Radio Co., Dept. PS11, 368 S. Meridian St., Indianapolis, Ind. 46225.

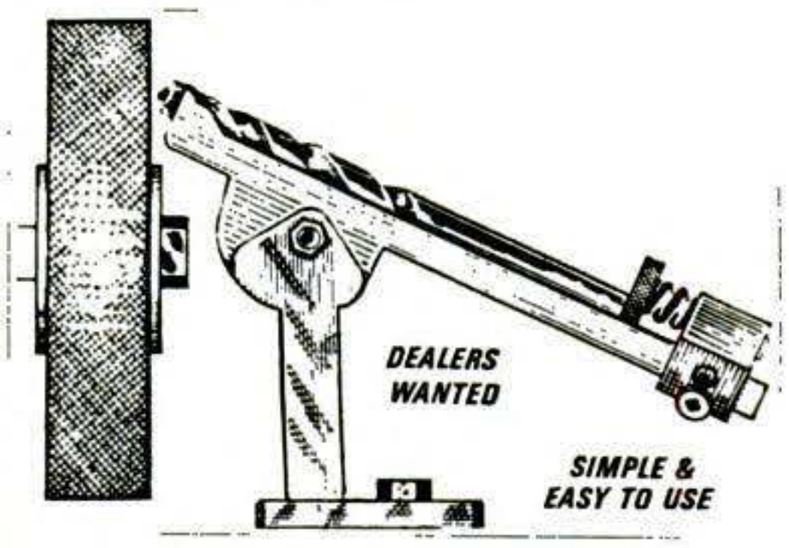
### *ARMY "MULES"*

4-wheel positive drive, hi flotation, lightweight (Magnesium construction) vehicle. $495 as received from Government. These and other rough-terrain vehicles such as "Coot" (shown above), "Viper", "Bear Cat", "Weasel", and Thiokol are available and in stock at The Depot, Highway 107 ByPass, Madison, Indiana 47250. Phone: Area Code 812-265-4291.



### *START YOUR CAR BY REMOTE CONTROL*

Ramostar, RAdio, MOtor, STARter starts your locked car from inside home, office, theatre, etc. from as far as 500 yds. away. Radio control, size of cigarette pack, operates without ignition key—theft proof. Over 32,000 combinations. Enjoy preconditioned car, warm in winter, cool in summer. Shuts off automatically after 2-6 minutes. $595 ppd. Free local installation. 1-yr. guarantee. Dealer inq. invited. Ramostar Corp., Dept. PR11, 708 Waukegan Rd., Deerfield, Ill. 60015.




### *GOOD BIT EASIER*

New, patented Per-Fec Drill Sharp-ner holds drill points in exact position for sharpening against grinder. Drill rests in the trough on a knurled screw which is adjusted with the aid of a spring. For the first time one step completes the sharpening without moving the position of the drill in the trough. Sharpens ¼" to ½" drills. Only $4.95 ppd. (Grinding wheel not included.) T. W. Simpkins Co., 4510 A Montana Avenue, El Paso, Texas 79903.

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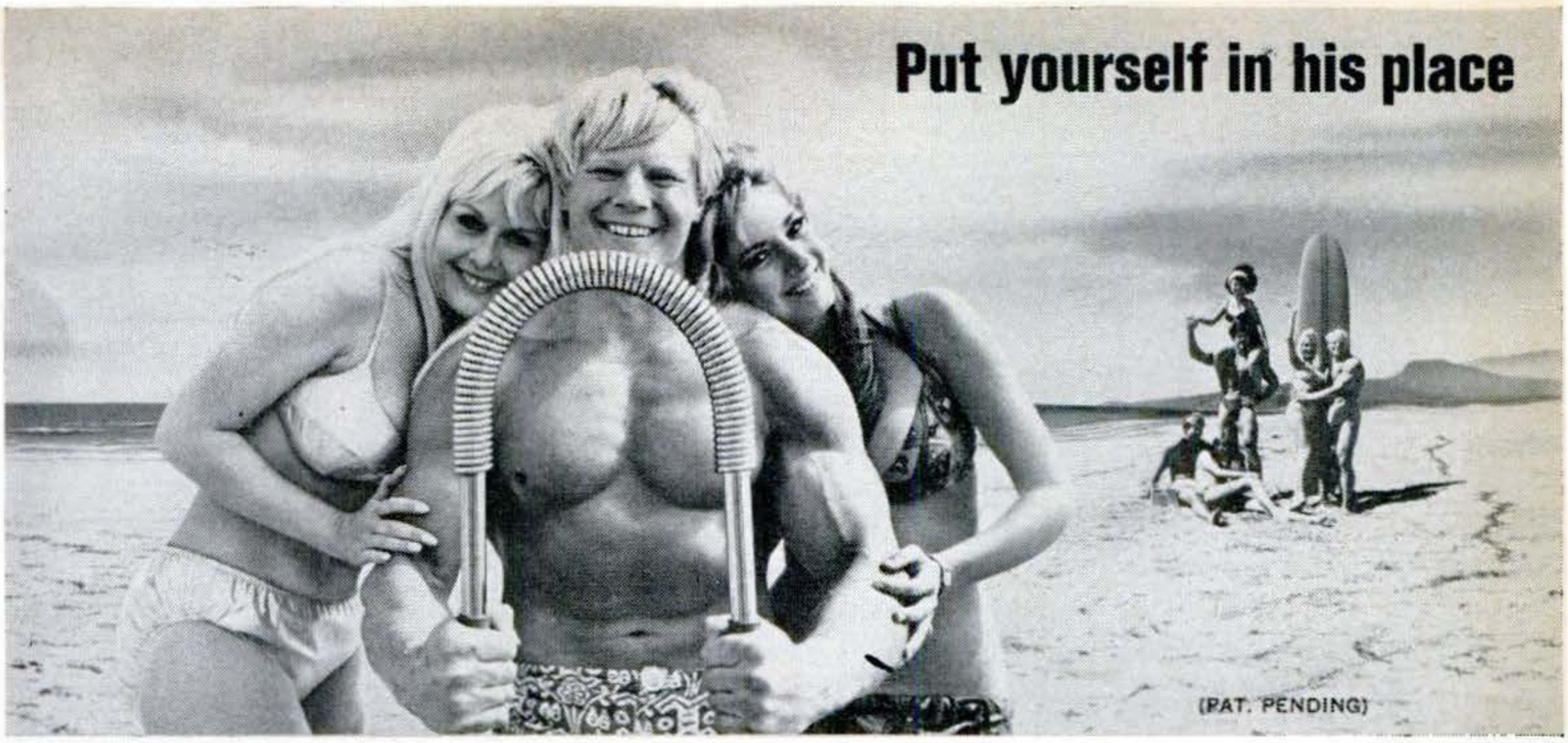


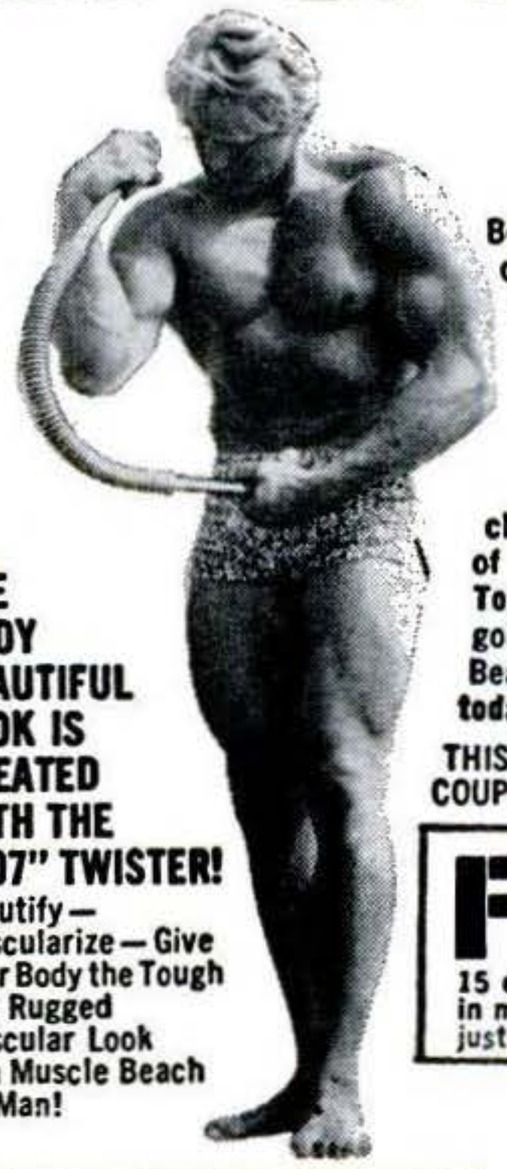

# MUSCLE UP & MAKE OUT

## ONE TWIST, IN JUST ONE SECOND, starts adding inches to your arms, chest, shoulders! WHY NOT YOU?

The **"007" TWISTER** is turning them on—even the Girls! From one end of Muscle Beach to the other, muscular things are popping up everywhere you go! The handsome, fun-going attractive fellows are twisting with the **"007" TWISTER** to add up to 2" on their arms, 4" on their chest, besides muscularizing their waists and building vigorous legs. They are giving the more than 500 muscles in their bodies a thorough going-over—to build power—rugged vigor—herculean muscular size, because they need **he-man muscles—for surfing, swimming** and **lifting girls overhead with one arm!** They know that **one twist** of the **"007" TWISTER** makes their muscles come alive with VIGOR...POWER...for **Super Happenings!** Don't you just read this ad—JOIN THE FUN! —SHAPE UP!—**And What Shape You'll Be In!**

## MUSCLES—ARE FOR REAL MEN!

See For Yourself What Super-Happenings You're In On When You Start Twisting With the **"007" TWISTER** and **Build Your Own Muscular Go-Go, Action-Packed Body**—all in the privacy of your own home!



**THE BODY BEAUTIFUL LOOK IS CREATED WITH THE "007" TWISTER!**

Beautify—Muscularize—Give Your Body the Tough and Rugged Muscular Look of a Muscle Beach He-Man!

## TURNS A MUSCLE-STARVED BODY INTO A DYNAMIC DYNAMO.

**Then become this new breed of wildcat!**

Be my guest—use the **"007" TWISTER** and if 5 minutes doesn't convince you that you too can easily toughen up and put yourself in this exciting, dramatic Muscle Beach setting, return it for a full refund? Fair? My **"007" TWISTER** is **Tough—Durable—Elegant,** made of chromed-steel tubing with easy to hold rubber grippers. As you take it in your hands, **the very first twist of its shiny coils** will make every muscle in your body COME ALIVE with Vigor and Power! It gently coaxes your arms, chest, back and legs into Super-Muscle Happenings, adding inches of rugged muscle all over your body! It makes you **Shape Up—Toughen Up—Muscle Up** FAST...the Muscle Beach Way! So start going with the youthful, fun-loving crowd **now**—bring some Muscle Beach excitement into your life—by ordering your **"007" TWISTER today!** IT'S GUARANTEED TO PRODUCE RESULTS—OR MONEY BACK!

THIS IS A LIMITED OFFER AND AVAILABLE ONLY THROUGH THIS COUPON—SO **HURRY!**

**FREE!** THIS 128-PAGE BOOK—to help you Muscle Up to a bigger, better, more "cut-up" body! Contains 15 exciting courses with over 200 photos of the Champs in muscle building action! A $5 value—it's yours FREE—just for ordering the "007" TWISTER! Get your copy now!

## JOE WEIDER
TRAINER OF THE CHAMPIONS

**ONLY $9.98 Postpaid**

Comes with FREE illustrated course of instructions.

**My Personal Guarantee:** YOU MUST BUILD A MUSCLE BEACH, "SUPER-HAPPENING", MUSCULAR BODY OR RETURN THE TWISTER FOR **EVERY PENNY BACK!** ORDER NOW!

**MAIL THE COUPON NOW & MUSCLE UP!**

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Union City, N.J. 07087

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Box 1667
Santa Monica, Calif. 90401

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*(See Yellow Pages of your phone book)*



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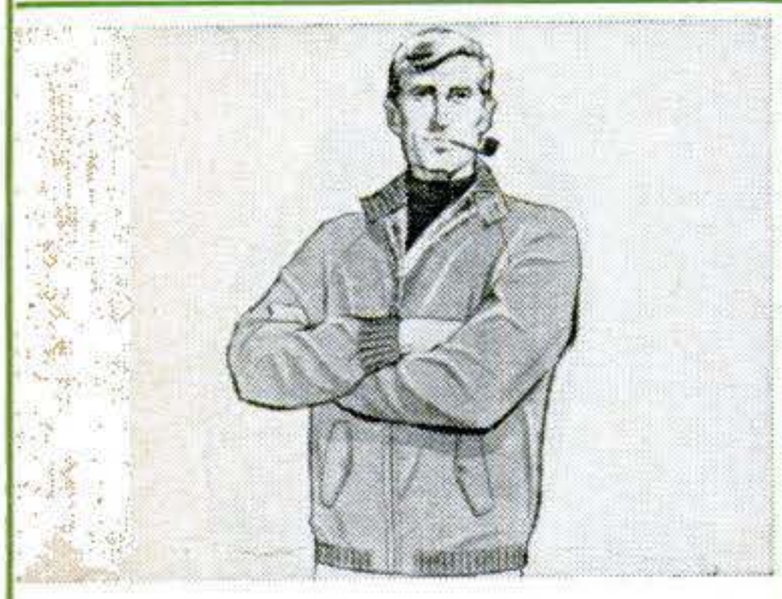

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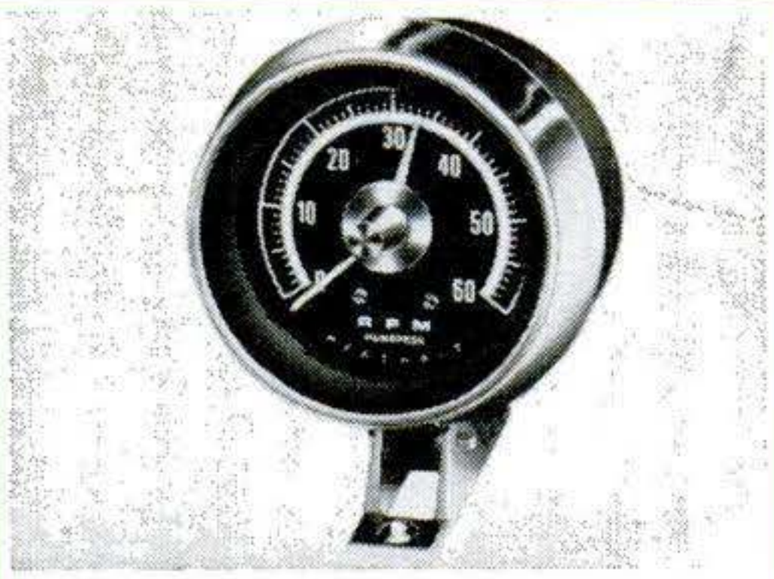
We specialize in sizes for tall and big men. Sleeves up to 38" . . . bodies cut 4" longer. Necks to 22". Large selection of Arrow and McGregor Perma-Press Sport & Dress Shirts, Sweaters, Slacks with longer inseams, extra long rise, waists 30"-60". Robes, etc. Plus 200 Shoe Styles 10-16 AAA-EEE. Hush Puppies, Dress, Casuals, Boots. By mail only. 100% Guaranteed. Write for Free 96-page Color Catalog. The King-Size Co., 6838 King-Size Bldg., Brockton, Mass. 02402.



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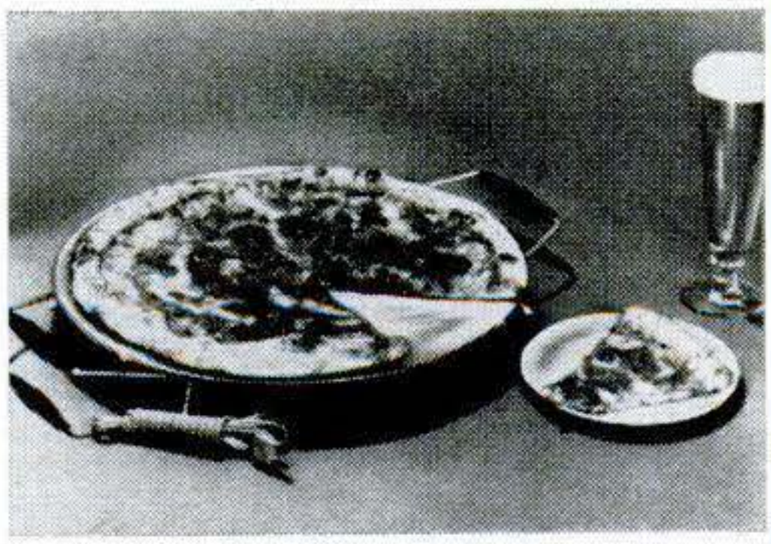
Unique inductive pickup—use on any spark engine & any ignition system; 2-cycle, 1-6 cyl. or 4 cycle, 2-8 cyl. engines. 0-6000 & 0-9000 RPM ranges, 250° lighted dial, ±4% accuracy from 0°-120°, adjustable red line, runs on 10.5-17.5 VDC power, stainless steel hardware, splashproof black & chrome case. MI-18-1 kit dash mounts—$29.95. MI-18-2 kit has mounting case & hardware—$32.95. Order from Heath Co., Dept. 16-11, Benton Harbor, Mich. 49022.

### *49-PC. BEGINNERS PHOTOGRAPHY SET*

Now everything needed to get started in the world's greatest hobby. Giant kit includes flash camera complete with Kodak film, flash bulbs, batteries, developing tank, print frame, safelite, trays, chemicals, paper. Plus darkroom accessories to make developing & printing fun. Easy to follow step-by-step instructions. Camera takes 16 pictures indoors or outdoors in B & W or color. 49-piece set only $12.95 p.p. Dicon Products Corp., Dept. PS, 2751 Carol Rd., Union, N.J. 07083.

### *FREE MUSCLE COURSE!*

Want a new Jet-Charged body? In 15 minutes I'll prove you can slap on 4" of muscles to your chest—3" to each arm—give you life-guard shoulders, trim your waist to athletic size—give you speedy athletic legs. I don't care if you're short or tall (skinny or fat) young or not so young, expect a muscle building miracle when you send for my free course. Send only 25¢ to cover postage and handling to Joe Weider, Dept. 100-118D, 531 32nd St., Union City, N.J.



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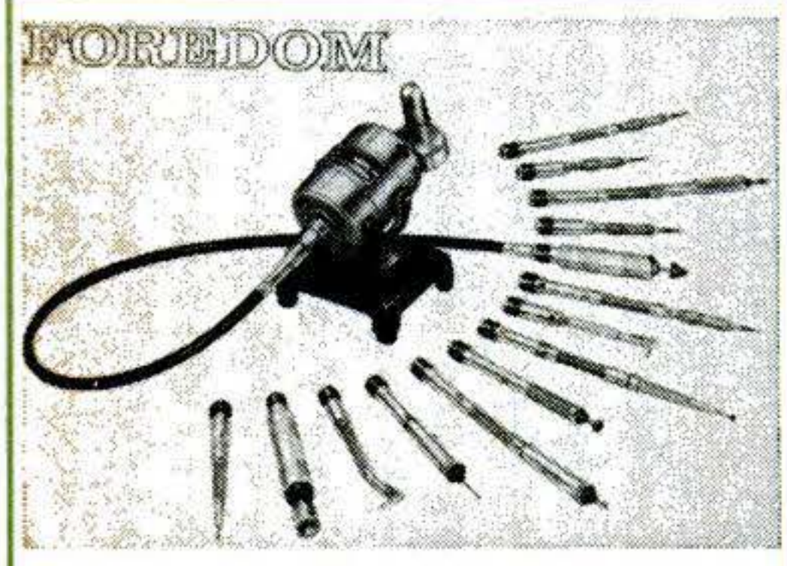
This U.L. Approved electric pizza warmer keeps your pizza hot & fresh right down to the last tasty morsel. Can also be used for hot pies, canapes, buns, etc. 16" diam. heavily chrome-plated tray (201 sq. in.) takes even the largest pizza. Heat is conducted evenly over entire surface within minutes. Walnut handles remain cool at all times. Wt. 4 lbs. Only $10.95 p.p Calif. residents add 5% tax. Almar House, Dept. 11-PS, 1263 Topaz Ave., San Jose, Calif. 95117.

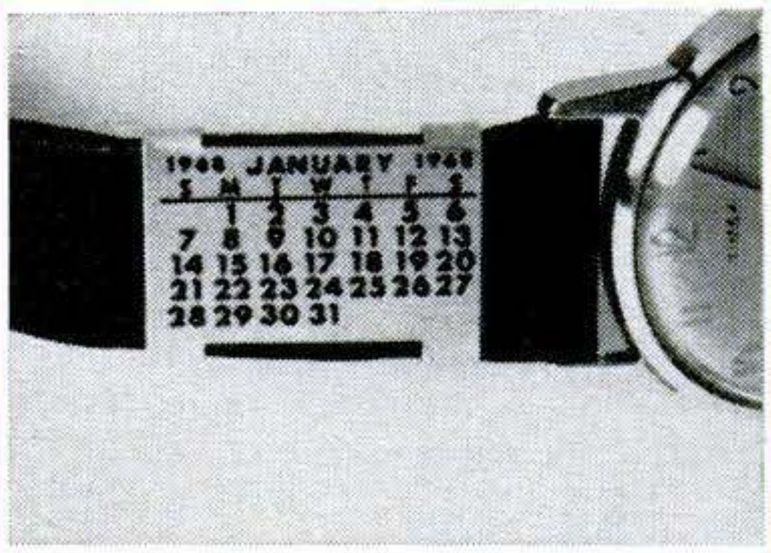
### *PSYCHEDELIC "SOUND TO LIGHT"*

Exciting kit enables you to have a discotheque light show with sound from phono, hi-fi, etc. Changes sound impulses into light keying signals. Model NAO-1 is wireless; sounds picked up by mike, amplified and applied to modulate silicon controlled rectified circuit—$9.95. Model BAR-1 uses no pick up or amplifier. Sounds fed to rectifier circuit to modulate lights—$5.95. Add 30¢ p.p. & hdlg. Modern Electronics, Dept. PS-118, Box 514, Livingston, N.J. 07039.




### *MINIATURE POWER TOOLS*

Used by professional craftsmen, model builders, lapidaries and industry for over 45 years. Ideal for grinding, sawing, drilling, deburring, engraving, carving, etc. 15 interchangeable handpieces. You can have a Foredom Flexade Shaft to fit on your own drill or motor for as little as $13.75; complete tools including motor and speed control from $36.50. Write for Free Catalog PS-255. Foredom Electric Company, Inc., Bethel, Connecticut 06801.




### *WATCH BAND CALENDARS*

See the date instantly on your wrist! These handy metal calendars fasten to the band of your wristwatch; fits either metal or leather bands. Printed on both sides (gold & chrome) to match watch. Set of 12 contains a new calendar for each month; 1969 sets now available in attractive gift box. Also available at quantity prices with imprint. Send $1.50 for each set or $7.50 for 6 sets to: Yoshida Co., Box 26878-C11, Los Angeles, Calif. 90026.

### *END BLINDING GLARE OF HEADLIGHTS*

Night-Driver-Viewer ends night driving fatigue & danger caused by momentary blindness from lights of on-coming cars. Equally valuable for driver and passenger. Worn like glasses or over glasses, yet no lens. Complete unobstructed road view. Comfortable, light weight, unbreakable plastic. Special offer—2 for $2 ppd. No C.O.D. Dealers write for franchise territory and quantity prices. NDV, Ramostar Corp., Dept. PS-11, P.O. Box 133, Deerfield, Illinois 60015.

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**Over and over up to 15 times or more**

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- **Charges all types of batteries.**

**Only Everlite charges tiny hearing aid batteries as well as big lantern batteries**

Only Everlite charges flashlight, toys, radio, telephone, hearing aid, cameras—yes, even mercury cells. Save money and have the convenience of fresh batteries. Simple, safe, foolproof and unbelievably efficient. Plugs into any 115 volt outlet. Free battery tester included. Guaranteed for one year.

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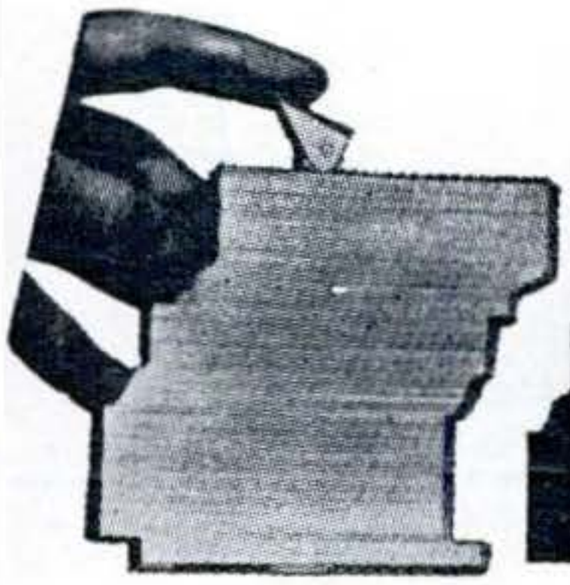

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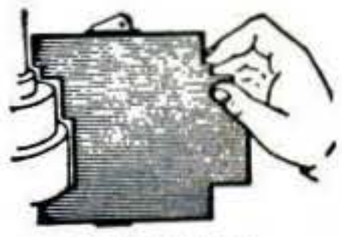
***Contour Copy***

*Copies exact outline of any object!*

Save dollars—save material. Can pay for itself on one job. The perfect tool for fitting in against door casings, bath fixtures, moldings, pipes, sinks, masonry, etc. A real boon to pattern makers, sheet metal mechanics, tool makers, body men, linoleum and floortile men, etc. EASY TO USE—Just push the gage leaves against any contour and lock. A perfect template every time. Works against any surface or any material.



TEMPLATES

**Made of hardened aluminum alloy. Size #1—4¼" x 4¼" $6.90 plus .65 shipping**

**Will retain its accuracy forever. Size #2—7½" x 4¼" $9.90 plus .75 shipping**

## ROYAL DANISH CONTINENTAL TELEPHONE

We import these distinguished looking telephones from Copenhagen. Used in the Royal Palace and in Danish Castles, these serviceable Magneto phones will add a unique continental atmosphere to any home or office. Two or more may be connected together and used as a private inter-com or telephone system. May also be converted to work as answering extension phone on your standard Bell Telephone System. Instructions included.

**Item #357, Danish Phone, Wt. 11 lbs. ..... $18.95**

**Item #357A, Danish Phone, converted for use on Bell System with wall plug attached ..... $22.95**

## STANDARD DIAL TELEPHONE

Western Electric and other standard phones same as used by all telephone companies. Easily installed as extension phone on any system. Readily adapted for private intercoms. Cost $40.00 new. These phones are guaranteed in excellent condition.

**Item #855NC, Wt. 8 lbs. ..... $7.45**

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Smart modern looking colored desk phone. Beautifully finished in french grey, beige, ivory or blue. Please specify. Easy to connect. Use as extension on any system.

**Item #1281, Wt. 8 lbs. ..... $12.95**

## 25 Ft. PHONE EXTENSION CORD

Lets you use your phone anywhere. Equipped with standard plug and jack to extend phone to any room.

**Item #1253, Wt. 3 lbs. ..... $2.95**

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Make your phone moveable. Male plug (attaches to phone)

**Item #1251 ..... $1.00**

**Female Jack (attaches to wall) Item #1252 ..... $1.25**

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## STANDARD DIAL WALL PHONE

A modern compact dial phone which hangs on the wall out of the way. Works with any phone system. Easy to install.

**Item #1266, Wt. 8 lbs. ..... $12.50**

## IMPORTANT

**All prices f.o.b. factory**

**10 day money back gty. on all items. Send check or money order. Prompt shipment assured. Send 10 cents for 100 page catalogue. Send $1.00 for C.O.D. shipments.**

# Master Mechanic Mfg. Co., Dept. B-118

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*Send orders to nearest office.*



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INSTANT PLUMBER blasts drains open with 60 pounds pressure thru hydraulic rocket action . . . all it takes is a gentle push from you and you get quick action on laundry tubs, bath tubs, kitchen sinks, showers, etc. A quality steel tool, only $5.95. We pay all shipping costs. MEREDITH, 310 W. 9th St., Kansas City, Mo. 64105.

## ONE HANDY TOOL DOES 4 JOBS!

**U.S. Ski Trooper's Hand Tool...**

One of the most practical tools you can own or give as a gift! Ideal for hobbyists, mechanics, do-it-yourself repairmen, fishermen, boating enthusiasts, etc. No looking for 4 tools that could be misplaced. Everything on this beautifully chrome plated "handyman." 4" diamalloy adjustable wrench, 6" slip joint wire cutters, pliers and screwdriver combined. Luxuriously white gift boxed. **Only $5.65 ea. or 3 for $14.50 ppd.**

## "OLD JUDGE" Solid Brass SPITTOONS

There are many ways you can use these beauties... as planters, as centerpieces, or as spittoons! You can even use them as mirrors — they gleam so brightly. They are just like the saloon and courtroom spittoons of our country's happiest days when a man worked for what he got and kept it. They are made in the USA by the only supplier to the chewing tobacco trade still in business. A quality item, hard to find, in two sizes . . . 5½ inches high, 4½" diameter, $10 . . . 7¾" high, 9" diameter $25... both postage paid.

**FRIGHT OWL**

Drive away unwanted birds from trees, fields, clothlines. Looks like real owl, mounts on post or swings from branch, etc. **$1** Plus 20c P & H

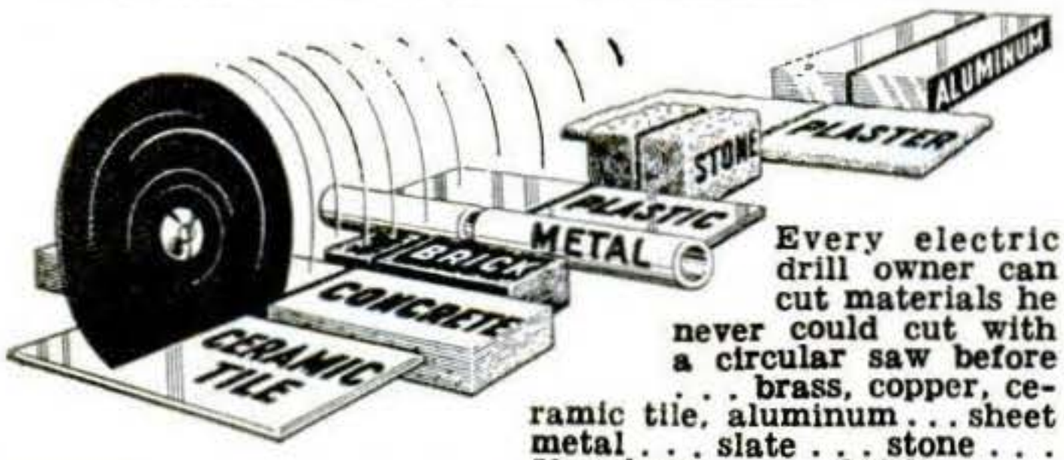
## STEEL SOUP-BONE

**Has 8 Swiveling Socket Wrench HEADS!**

8-Ender is a full sized offset 8 head socket wrench. The heads swivel, making available the right socket-size when needed. Ideal for tractors, autos, tillers, pumps, etc. Does work of full sets of socket, open end or box end wrenches.

Drop forged, chrome vanadium steel, in regular sizes 7/16 thru ⅞" . . . also in metric model from 9 mm thru 24mm. Be sure to specify which model you wish. $6.95 each postpaid. 2 for $5.95 each.

## Professional NAVAL ROUND SAW




Every electric drill owner can cut materials he never could cut with a circular saw before . . . brass, copper, ceramic tile, aluminum . . . sheet metal . . . slate . . . stone . . . fiberglass . . . brick . . . cement . . . stainless and other steels, even a hardened file! **NAVAL Round Saw** has silicon carbide grains imbedded in an open weave nylon mesh. No sharp teeth grab the work and throw it back at user. And it is a sanding disc too! Use it to sand and shape all metals, wood, tile, glass, paint, rust, etc. This 7" disc comes complete with 5" rubber disc for sanding and shaping applications, a ¼" shank arbor, 2 steel flanges and an excellent instruction sheet.

**Order NAVAL Round Saw . . . $5 for one, 3 for $4.50 ea. (total $13.50) 6 @ $4 ea. (total $24) . . . 24 @ $3.50 ea. (total $84)**

## $70 AIR-GUN only $29.95

Complete with chisel this 3 lb. Air-Gun rips into metal, chips concrete, drives pins, etc. Delivers 5500 2" strokes a minute. Operates on 3 to 5 hp compressor. Made especially for govt. and manufacturer made too many. At only $29.95 ppd. while they last, a $70 value. Three extra attachments for exhaust pipe cutting and other uses $9 ppd.

**MEREDITH,** Dept. PS-11, 310 West 9th St., KANSAS CITY, MO: 64105

**MEREDITH SEPARATOR Co., Dept. PS-11, 310 West 9th St., Kansas City, Mo. 64105**

Ship as follows: (see coupons on page to right)

☐ Drain Blasters ☐ Fright Owls ☐ Steel Soupbones
Round Saws ☐ 1 ☐ 3 ☐ 6 ☐ 24 ☐ Air Guns
☐ AG Extras
Ski Tools ☐ 1 ☐ 3 (write for prices on Japanese copy of this American product).



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**Polyurethane that applies like paint forms a skin so tough it won't crack, chip or peel. Cuts painting costs . . . covers and protects like a shield of unbreakable glass.**

# WATERPROOF in 30 MINUTES

**Adheres to practically anything, stops leaks. Ideal for concrete, aluminum, wood, masonry, canvas, any metal. Clear—any major color. Just specify. $5.95 per qt., $18.50 per gal. We pay all shipping costs. Order NAVAL 5.**

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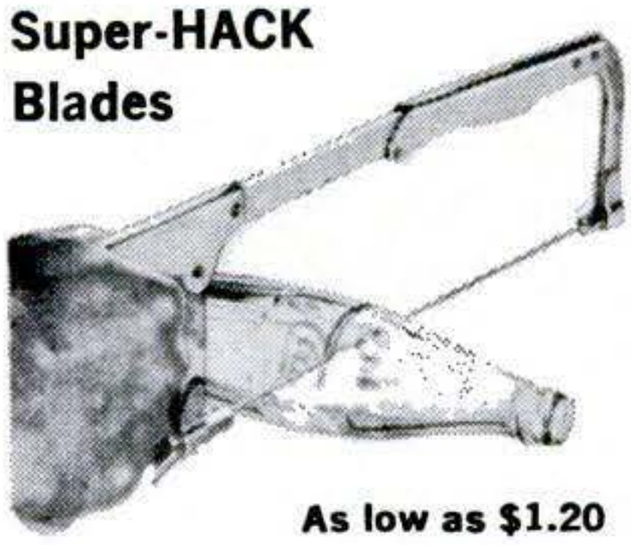
**ORDER ALL ITEMS ON THIS PAGE FROM MEREDITH, see coupon below**

## CUT ANY MATERIAL with Naval Super-HACK Blades



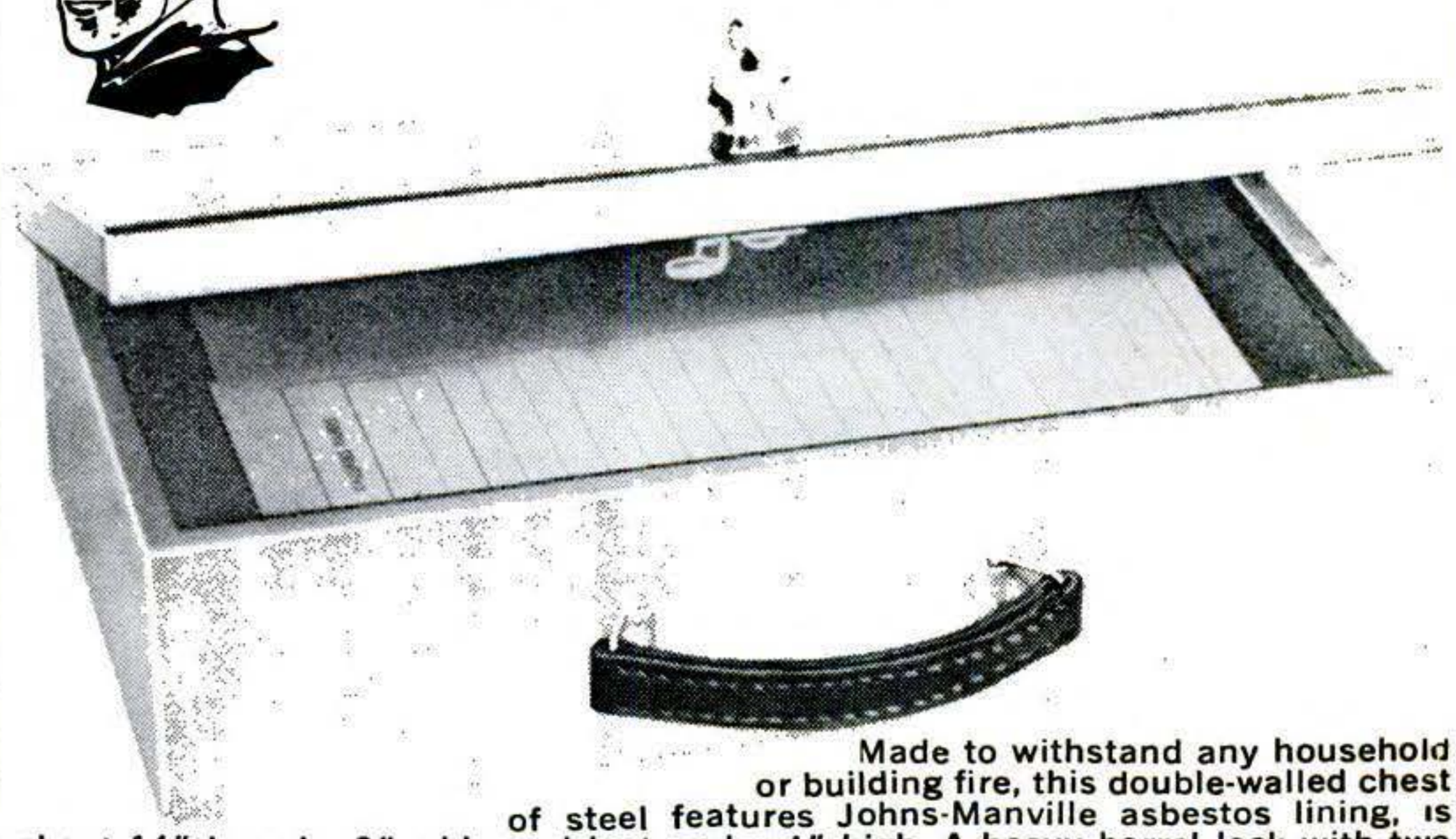
**As low as $1.20**

Rip thru hardest metal (a file) in less than 2 minutes. Cut even curves or notches in materials formerly considered unsawable . . . like glass, glazed tile, bricks, tool steel, marble. Very little effort. This famous cousin of the diamond, furnace-born tungsten carbide, now joins the rod saw blade. Fits any hacksaw. Only $2.79 for one blade. 3 for $6.20, 6 at $2 each (total $12) ppd. 24 @ $1.60 ea., 100 @ $1.20 ea. all postpaid.

**MEREDITH**
**Dept: PS-11, 310 West 9th St., KANSAS CITY, MO. 64105**

**Naval Carbide Drill Bits for glass, steel, etc. in diam. 1/16" and 1/8" for $9 and 1/4" $16 ppd.**

# Johns-Manville Asbestos-Lined STEEL FIREMAN'S SAFE



Made to withstand any household or building fire, this double-walled chest of steel features Johns-Manville asbestos lining, is about 14" long by 9" wide and just under 4" high. A heavy barrel lock with two keys protects contents from theft. The lid has a full length piano hinge like industry seldom makes anymore. You get five valuable paper folios . . . for insurance, cash reserves, social security records . . . children's health certificates . . . personal family records . . . priceless photographs . . . stocks and bonds. Baked enamel outer finish makes chest attractive and luggage-style handle makes it easy to carry this 8½-lb. UNDERWRITER'S Safe. $15.95 (We pay all shipping costs.)

**MEREDITH SEPARATOR CO., Dept. PS-11**
**310 West 9th St., Kansas City, Mo. 64105**
**Regular Model @ $15.95** ☐

Double Capacity Box (same rectangular dimensions but twice as deep) and worth much more. $22.00 ☐.

Name . . . . . .
Address . . . . . .
City . . . . . State . . . . . Zip . . . . . .

# $50 REWARD

for Any Spider, Bug, Insect that Bugmaster Electric Units fail to kill. Here is your automatic, odorless electrical way to rid apartment, home, office or plant of disease carrying bugs, roaches, fleas, bedbugs, ants, moths, silverfish.

**KILL BUGS INDOORS**
**The Institutional Way**

- ☐ Model H—$9.95 plus 75¢ p&h
- ☐ Xtra Crystals for H—75¢ per box
- ☐ Model G—$15.95 plus $ p&h
- ☐ Xtra Crystals for G—$1.50 per box

Model H—6,000 cubic feet
Model G—12,000 cubic feet

*When ordering re-fill crystals alone please add 45¢ p&h*

# WATCH RUST DISAPPEAR NAVAL JELLY

is an extremely active new cleaner that removes rust by chemical combination . . . sticks to verticals and overheads. Brush it on, hose it off.
Use on pipes, fences, tools, tanks, all machinery. Eliminates sandblasting, scraping, etc. Easy and quick.

☐ 40# @ .65/lb. $26
☐ 10# @ 1.50/lb. $15
☐ 4# @ 2.00/lb. $8.00
#4 ppd.—other units FOB KC

**Naval Formula X-300 Closeout Prices of this half-strength blue material write for details.**

**MEREDITH SEPARATOR CO., Dept. PS-11, 310 West 9th St., Kansas City, Mo. 64105**

Ship as follows: Satisfaction Guaranteed: ☐ Carbide Drills (specify diameter)
☐ Super-Hack ☐ 1 ☐ 3 ☐ 6 ☐ 24 Bugmasters as checked above ☐ Naval Round Saws ☐ 1 ☐ 3 ☐ 6 ☐ 24. ☐ Naval Jelly as checked above ☐ Naval 5 ☐ Qt. ☐ Gal. Steel Fireman's Safe ☐ Reg. ☐ Double depth

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City . . . . . State . . . . . Zip . . . . . .

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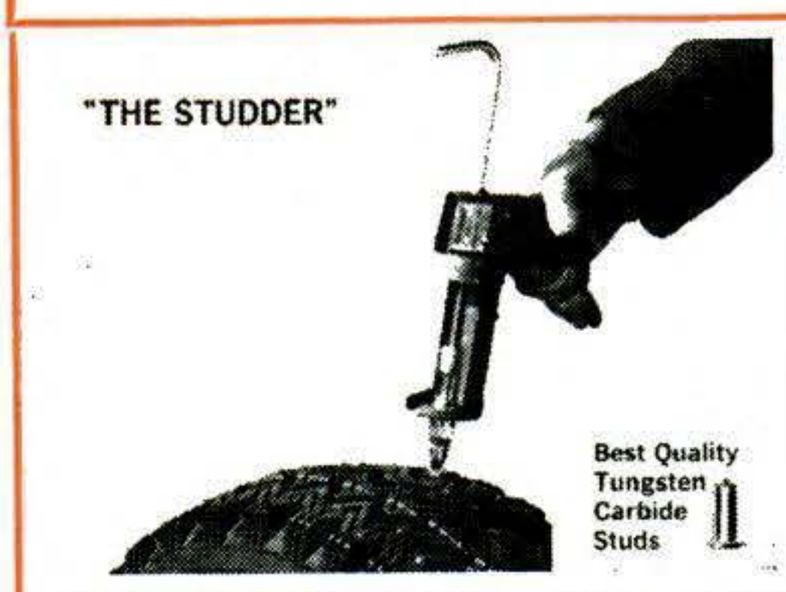


### STUD YOUR OWN SNOW TIRES & SAVE!

THE STUDDER easily opens molded stud holes and seats studs securely in inflated tires—even tires already driven, instructions cover gravel removal. Studder gun—$4.95; tungsten carbide studs, passenger car sizes —4c each; or save $2.20 on complete kit: Studder, 180 studs (for 2 tires), instructions —only $9.95. Ppd. Advise measured stud hole depth. Check or MO. No C.O.D. 3% tax on Colo. and Kans. orders. Traction, Inc. P.O. Box 15112, Denver, Colo. 80215.

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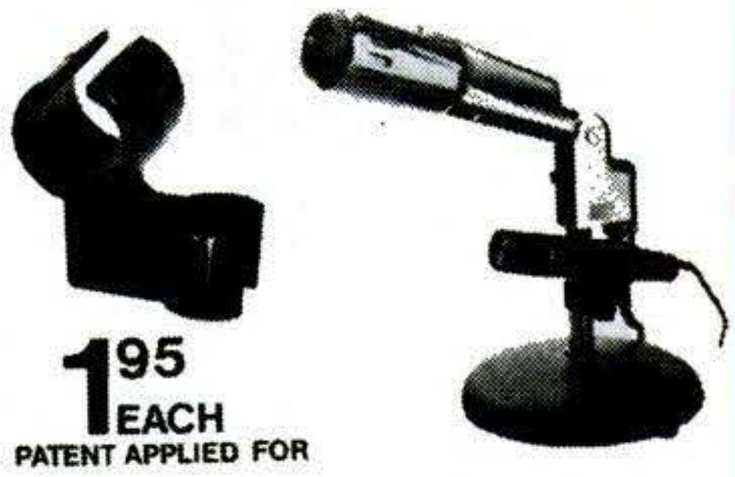


### "SNAP-ON" MICROPHONE ADAPTER

Plan your next recording session with confidence using this new, unique, recording-microphone snap-on adapter which allows you to use any existing microphone stand for your pencil mikes. Just snap this flexible, nylon adapter onto the shaft and slide your mike into the expanding collar varying from 25/32" to 1⅛". It also adapts to conventional music stands. Felt liner included. $1.95 H & H Plastics, Dept. PS, P.O. Box 5396, Sarasota, Fla. 33579.

### BUILD THIS "ALL WOODEN" CLOCK

Complete plans for the most talked about show-piece in town. This clock is 100% wood, all working parts fully visible. No special tools req. Separate hour, minute & second hand, weight driven, keeps perfect time. May be mounted in large grandfather case or displayed on pedestal. The simplest, yet most unique item for the woodwork hobbyist or clock enthusiast. Plans only $4. R. D. Thomas, 1412 Drumcliffe Rd., Winston Salem, N. C. 27103.

### HANDY DANDYS KEEP SUPPLIES NEAT

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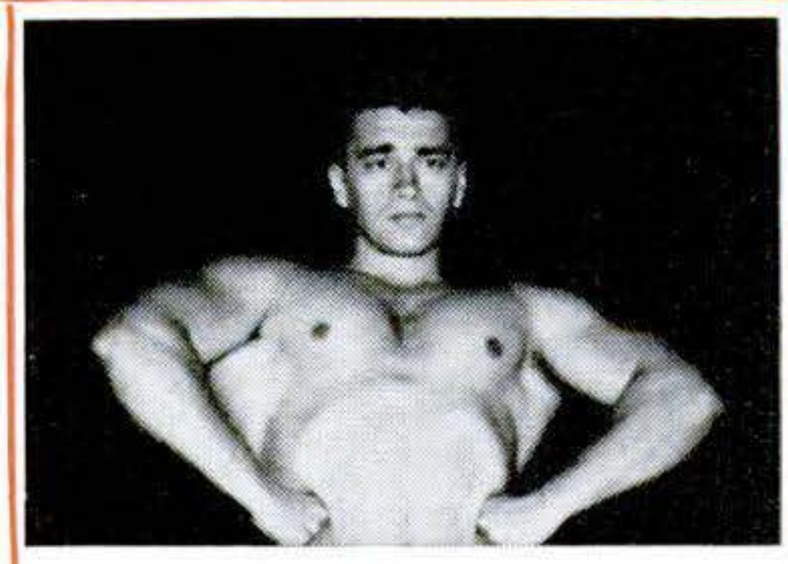

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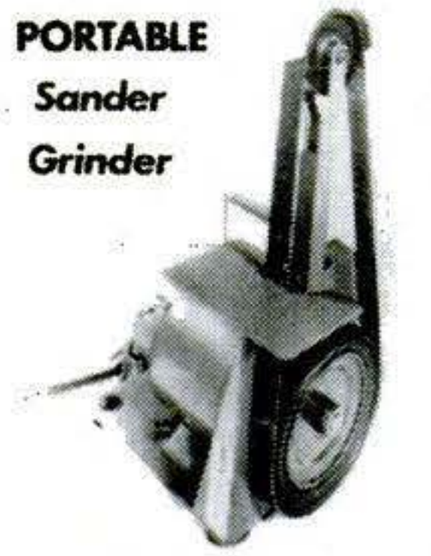
Fantastic New Discoveries in the science of bodybuilding. Now, in the privacy of your bedroom, our method will add inches of powerful muscles to arms, chest, shoulders & legs. Learn secrets on trimming the waist with ultra-modern methods—fast! Regardless of age, skinny or overweight, we can transform your body to physical perfection. Results Guaranteed! Send for free brochure. Universal Bodybuilding, Box 4327 A-25 Northeastern, Dearborn, Mich. 48126.

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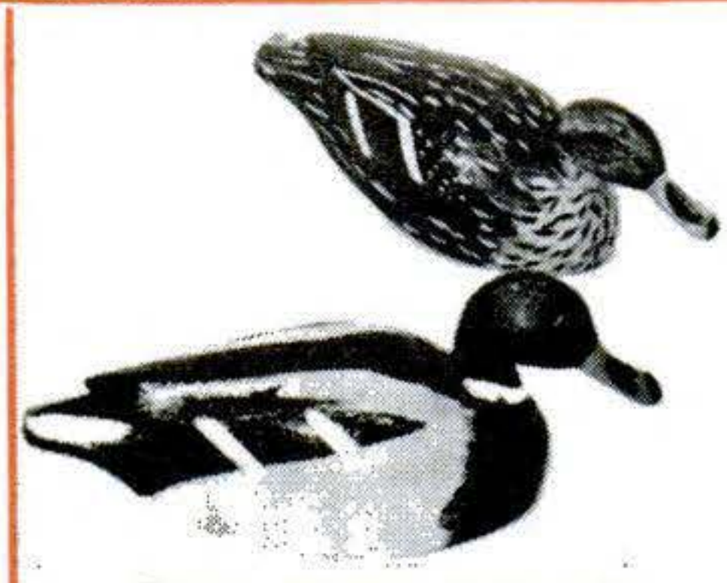
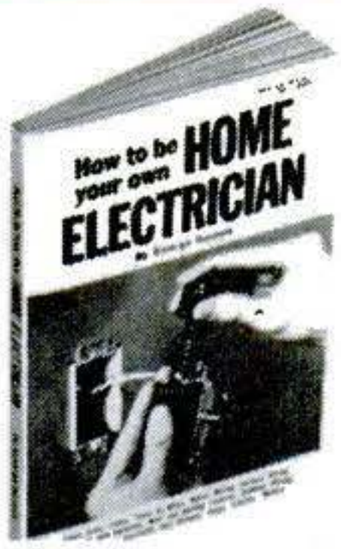


### HAND CRAFTED MALLARDS FOR SPORTS AND DECORATION

Durable canvas perlite bodies & hand carved wooden heads are features of these imported Italian decoys. Lifelike and exact in every detail, these hand-painted ducks are available in both male & female mallard ducks. Ideal men's gift for wingshooting or decoration of den, gunroom, office or playroom. $5.95 each + 25¢ post. or 2 for $10.98 + 50¢ post. Dicon Products Corp., Dept. PS, 2751 Carol Rd., Union, N.J. 07083.

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"How to Be Your Own Home Electrician," by George Daniels. Picture-clear instructions for handling everything from splices & switches to full service wiring. All about tools, codes, types of wire, indoor & outdoor lighting, fuses, fluorescent lighting, etc. Plus essential electrical theory. Pointers on trouble shooting & circuit testing. Paperback. Many photos & drawings. $1.50. Popular Science Skill Books, 44 Hillside Ave., Manhasset, N.Y. 11030.



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All the equipment for basic electrical experiments with **Wheatstone Bridge** (measures resistance), **Magnetizer** and **De-magnetizer, Thermocouple, Mystery Shock Box, Continuity Tester, Extinction Voltmeter, Solenoid Coin Tosser, Electromagnetic Relay, Neon Lamp, Galvanometer, Induction Coil, Resistors,** Chemicals and Electrodes for Plating and Electrolysis. **FOR SAFETY** a step-down **Isolation Transformer** provides required current.

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**YOU BUILD A SHORTWAVE AND BROADCAST RADIO.** 3-tube regenerative receiver [illegible] **CARBON MICROPHONE** with **AUDIO AMPLIFIER, RADIO TRANSMITTER** for voice or voice. **RIPPLE TANK WAVE GENERATOR** with variable frequency. Invaluable in the understanding of wave theory. **CODE PRACTICE OSCILLATOR** with manual, **"Steps to a Ham License."** All you need to pass the FCC Ham License Exam.

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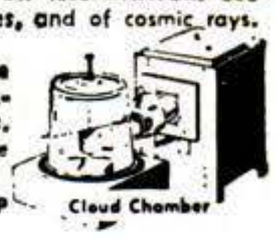


**ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR.** See the vapor trails of alpha and beta particles, and of cosmic rays. **SPINTHARISCOPE.** Shows exploding atoms. **ELECTROSCOPE** — metal housed with **Scale** and **Magnifying Viewer.** Measures background radiation and tests sample sources. **SAFE RADIOACTIVE MATERIALS.** Alpha Source in handy container and Uranium Ore. **Full instructions and explanations open up the fascinating field of nuclear physics.**

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**A Neon Lamp** that flashes at intervals you can synchronize with the speed of rotating or vibrating objects in order to "freeze" their motion to permit close study and checking frequencies and RPM. Flashes are timed by a variable frequency oscillator with a range of 20 to 600 cycles per second.

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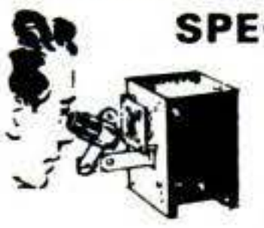
**SIGNAL TRACER.** A valuable trouble shooting tool which permits you to "listen in" as you probe through a faulty circuit until you find the trouble spot. **CONTINUITY TESTER.** Finds open circuits and test voltages. The use of both pieces fully described in accompanying manual, **"Simplified Radio and TV Servicing."**

### SPECTROSCOPE



Analyze spectra of glowing gases. See and identify the Fraunhofer Lines. A quality instrument featuring an **easy-to-read built-in scale and a powerful condensing system** for a bright spectrum. Equipment includes **Alcohol Burner** and a **2 Watt Neon Spectral Lamp. Full instructions cover theory and use.**

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**Crystal Photocell, Electronic Amplifier, Relay, large Condensing Lens in Cabinet Mount.** Features automatic on-or-off or holding circuit operation. Sensitivity Control, Plug-in Outlet for controlled circuit. Use for alarms, counters, etc. Operates on 115V AC. **A basic unit for many exciting experiments.**

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Changes regular 110-120V AC to the direct current required for electronic projects and experimenting. Consists of a **Power Transformer, Vacuum Tube Rectifier, 20/20 MFD Capacitator Filter Circuit, and a potentiometer Voltage Selector.** A Safe Isolated Power Supply eliminates the need of expensive multi-volt batteries.

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**140 watt filter type UV LAMP.** Heavy metal cabinet. 6 Foot Cord, Rotary Switch. Produces dazzling color effects with invisible black light. Has many uses in the fields of Mineralogy, Crime Detection and Science. Accessories include **Invisible Ink, Tracer Powder, Fluorescent Crayons.**

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**Electronic Computer multiplies, divides, calculates powers, roots.** Set up the problem on the scales of two potentiometers and find the answer on the scale of third potentiometer as indicated by a sensitive meter. Instruction Manual covers computer theory and practical use. Over 150 sample problems and answers demonstrate use with fractions, trigonometry, logarithms, physics formulas, ballistics, etc.

### MICROCRAFT LAB

**Microprojector** shows microscopic subjects enlarged with brilliant detail on wall or screen. Has sturdy Steel Cabinet, large Condensing Lenses for extra brightness, and a GE Projection Lamp. **Microscope** features Ramsden Eye-piece for wide field viewing, Substage Light and Polarizing Filters. Magnifies up to 200X. Includes: **Slides, Cover Glasses** and **Microscopy Manual.**

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**A practical Transit. 6X erect image telescope with Range Finder Reticle for measuring remote distances and heights.** Vernier reading for both horizontal and vertical scales. Leveling Head with Thumb Screw Adjustment and Spirit Level. Clamps under head hold wooden legs of Tripod. (Legs not included.) **Instructions cover elementary surveying, range-finding.**

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Measuring Wavelength of Light

Exciting optical projects for the study of light. Equipment includes: five **Precision Lenses, Prism, Polarizing Filters, Diffraction Grating, Mirror, Telescoping Tubing, Lens Mounts, Tube Holders and Brackets.** All the parts and instructions to build a Camera Obscura, Camera Lucida, Polariscope, and many other optical devices.

### PHOTOMICROGRAPHY CAMERA

**Photographs subjects mounted on microscopic slides.** Enlarges up to 100X. Takes clear sharp pictures of specimens too small to be seen with the naked eye. **A fully self-contained unit** — no microscope required. Uses standard roll film, either 120 or 620, black and white or color. Make a photographic record of your projects with microscopic subjects.

### TELESCOPE AND MOUNT

**30X erect image.** Extends to 30" length. Five ground and polished Lenses. **Ramsden Eyepiece. Sturdy Equatorial Mount** makes it easy to follow the movement of heavenly bodies. Mount has fittings for wooden legs that complete the tripod (legs are regular 1x2 lumber not included).

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**A PRECISION 35MM ENLARGER . . .** horizontal type with twin condensing lenses and 3" F/L projection lens. Produces quality enlargements up to **8"x10".** Contact Print Frame takes negatives up **3½"x4¼". 3 Plastic Developing Trays, Neon Safelight, Tray Thermometer, Film Clips, Developing Chemicals, Printing and Enlarging Paper and Darkroom Handbook.** Make quality enlargements for **6¢.** Make prints for only **2¢.** Full instructions.

### LIGHT TRANSMITTER-RECEIVER

Talking on a Light Beam

The **TRANSMITTER** consists of a **Light Source, a Modulating Reflector Diaphragm** and an Optical Projection System. The **RECEIVER** is a **Two-Stage Audio Amplifier,** controlled by a Photoelectric Cell that catches the projected light beam and causes the original sound waves to be reproduced in the headphone.

### WEATHER STATION

**A REMOTE READING ANEMOMETER AND WIND-VANE . . . Flashing Neon Lights** on indoor indicator board show wind speed and direction. **Safety Power Cord** makes all connections safe. 100 ft. of Lead-in Wire. Plus—**Air Tank Barometer** with 4ft. indicator column. **Sling psychrometer** measures relative humidity. **Rain Gauge** measures rainfall to 1/100 inch. ALSO Cloud Chart, Weather Map and Forecasting Manual—a complete set-up for amateur meteorology.

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SEND ONLY **$1.00** TO ENROLL

PAY ONLY **$4.95** FOR EACH KIT THAT YOU RECEIVE

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**Q. How is it possible? It seems incredible to be able to get all the equipment shown above in just nine kits—at only $4.95 per kit!**

**A.** The direct-to-you "no middleman" club plan is just part of the answer. The other key is ABSClub's especially designed multi-use equipment. For example: the Microprojector quickly and easily converts into the Spectroscope, Photo Enlarger and Cloud Chamber Illuminator. Similarly, the Transit doubles as a Telescope Mount. Such multi-purpose design . . . plus club plan economy . . . makes possible this all-science program at a price everyone can afford.

**Q. May members choose the order in which they receive their kits?**

**A.** Yes. With the first kit members receive a list of the equipment and projects contained in each of the remaining eight kits. With this information they are able to choose the kit sequence that best suits their particular interest.

**Q. Can members get their kits all at once instead of one-a-month?**

**A.** Yes. At any time members can have the balance of their kits sent in one shipment. We recommend that you start on the kit-a-month plan because the monthly spacing will give you time to get the full measure of knowledge and enjoyment that each kit has to offer.

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- ★ **$1.00 is the full cost of membership.**
- ★ **You take only as many kits as you wish.**
- ★ **Two weeks approval on each kit you take.**
- ★ **You may return any kit for full refund.**

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☐ I enclose $1.00 to enroll and $4.95 for the first kit postpaid.

☐ I enclose $1.00 to enroll. Send first kit COD. I'll pay COD fee.

I understand if I am not satisfied with the first kit I may return it for a complete refund including the $1.00 membership fee.

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# FLAME GUN

**KILLS WEEDS, MELTS ICE FAST!**

**Clears hundreds of yards of icy driveways, steps, walks, etc.**

**Exterminates leaves, rubbish, mess for fast cleanup.**

**THOUSANDS SOLD IN ENGLAND**

From England—remarkable 2-in-1 Jet Rod Flame Gun kills weeds instantly—without bending—melts ice in winter. Exterminates leaves, rubbish, mess for fast clean-up. Works effectively (using only one hand) to quickly melt hundreds of yards of dangerous icy driveways, keep flagstone & cement walks clear, manicures borders & edges, routs out breeding insect nests, sterilizes ground & kills acres of weeds. No batteries or costly fuel. Less than 2 pints of kerosene give 30 minutes continuous use. Order now for fast guaranteed results without backbreaking bending, saving you hundreds of dollars year after year. Only $29.95 Ppd. Satisfaction guaranteed or money back.

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**PICKS UP PHONE CALLS**

Amazing electronic DETECTIVE DEVICE (Not sold where illegal:) Lets you monitor conversations undetected. Listen in on an extension Without Lifting Receiver. Similar units sell for $10. Now only $2.98 while they last. **WORLD CO., Dept. 11PS, 1 Park Ave., New York, N.Y. 10016**

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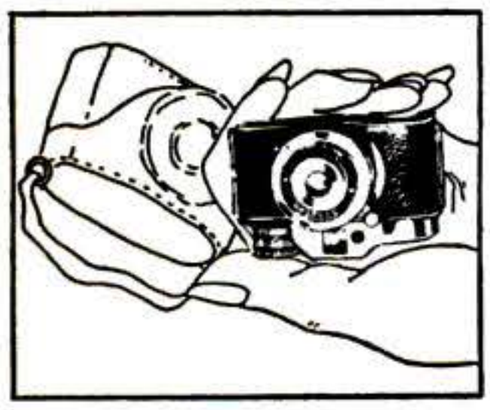
**Inflates 12 to 18 feet high**

Great year 'round gift for backyard, park, beach, fun. Spectacular way to advertise store openings, sporting events, etc. Durable long-lasting U.S. Gov't surplus neoprene rubber! Gov't surplus inflates easy with gas, air. Supply limited. **Only $2.98 plus 50¢ pp & hdlg. WORLD CO., Dept. 11PS, 1 Park Ave., New York 10016**



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**FITS IN PALM OF HAND. Not sold in states where this may be illegal.**

Secret spy camera only 2" long, so small you can close your hand over it. Imagine all the wonderfully candid snapshots you can take when subjects are unaware. With view finder, 1/25 shutter, carrying case. Each roll takes 10 photos. Refill pack includes 6 rolls of film. Takes fabulous pictures!

**SPY CAMERA..... 99¢ REFILL PACK ..... 79¢**

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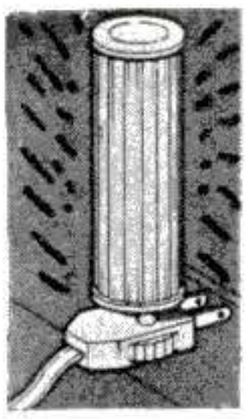
## POWERHOUSE INDOOR TV ANTENNA



**Uses house wiring system. Brings in all channels & fringe areas sharp & clear.** Electronic marvel converts your house wiring system into Powerful Antenna. Brings in every channel plus fringe areas sharp & clear like giant outside aerials. Helps eliminate noise, snow & flicking. Just plug into wall outlet. Uses no current. **$1.98**

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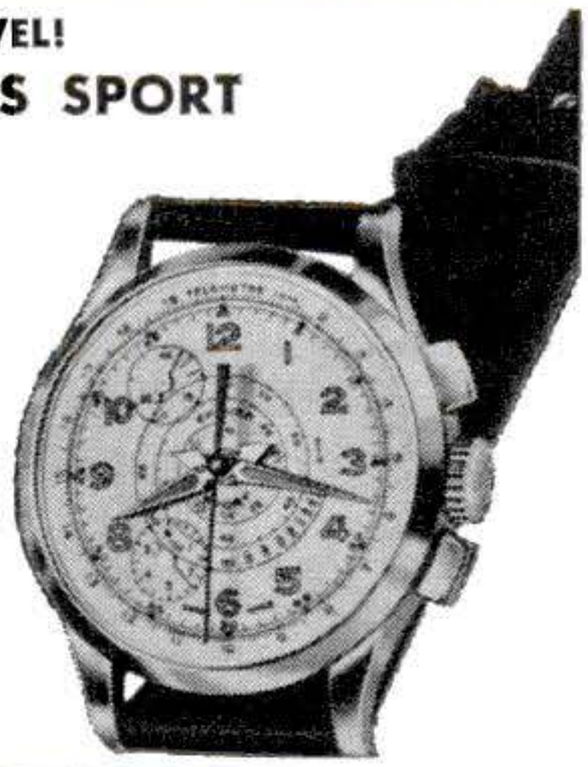

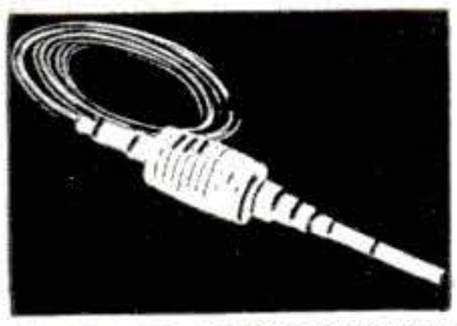

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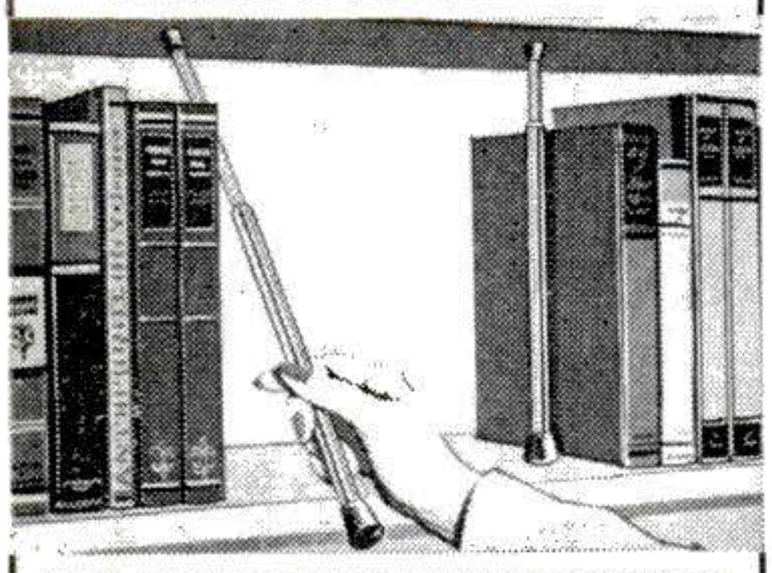

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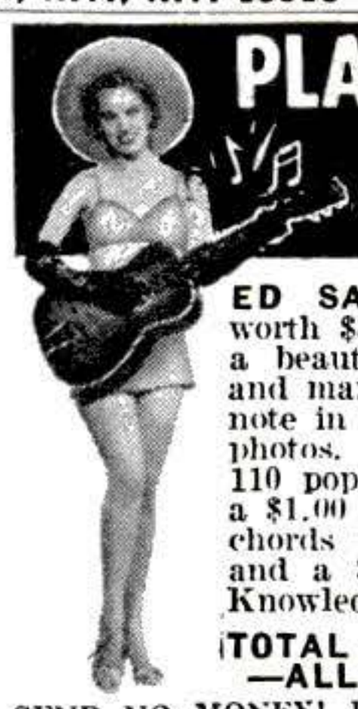

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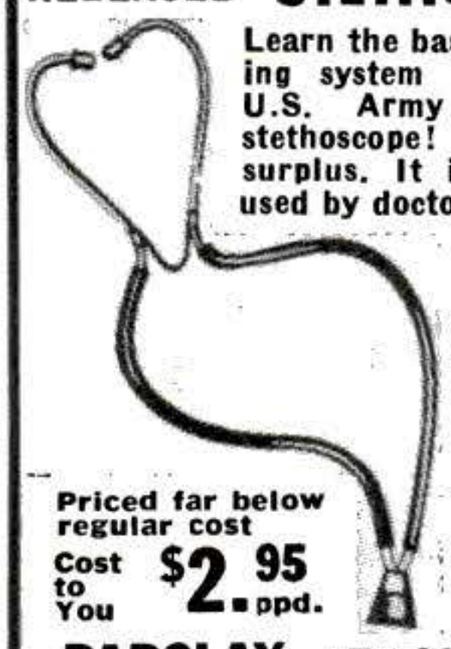

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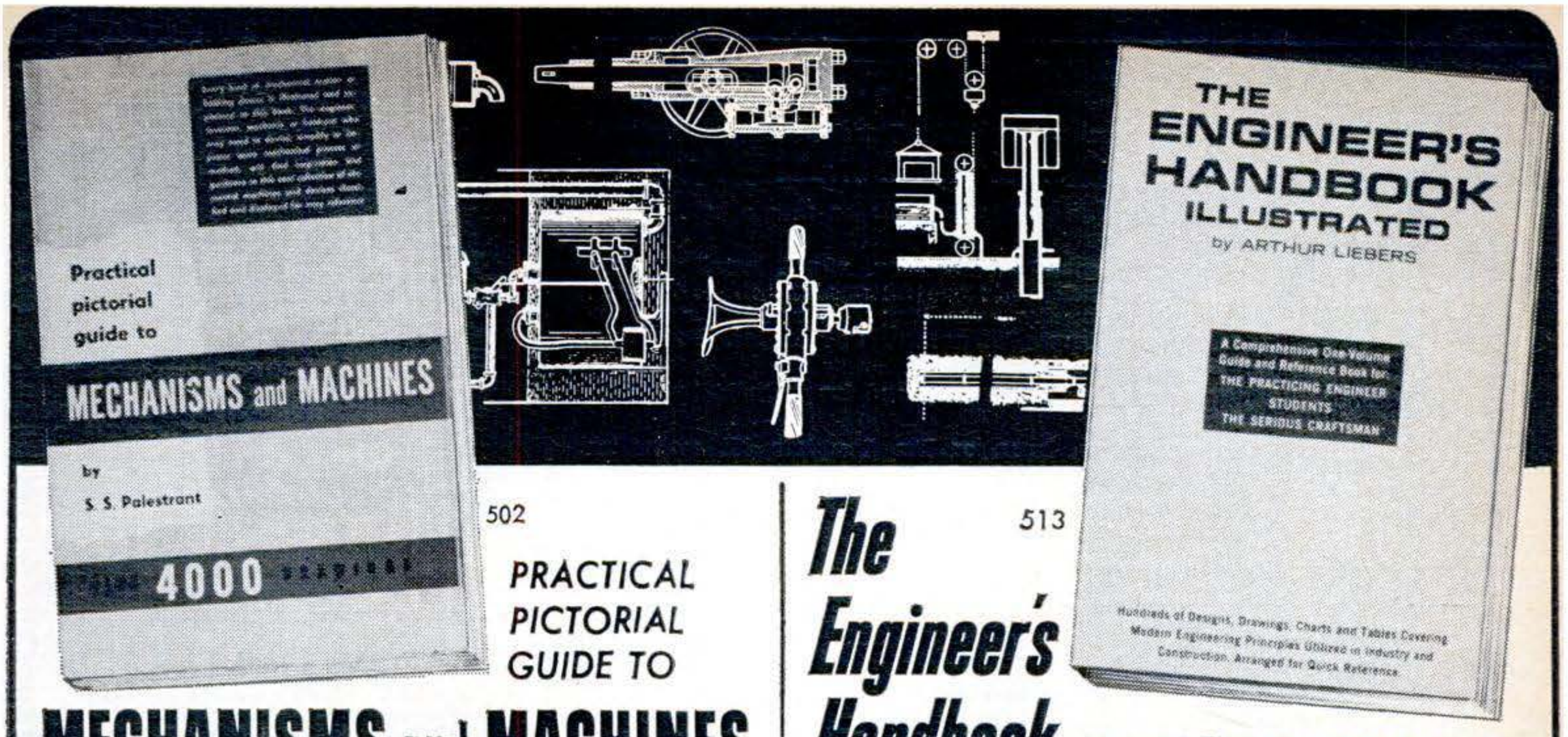


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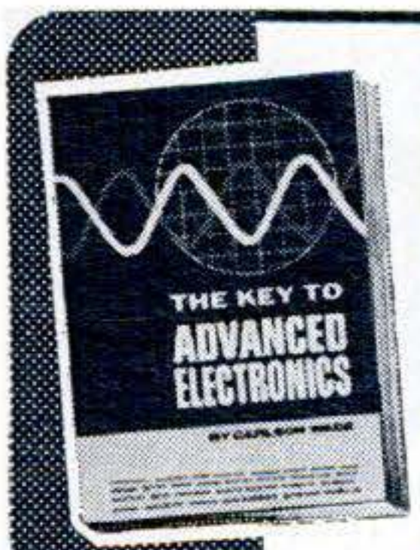


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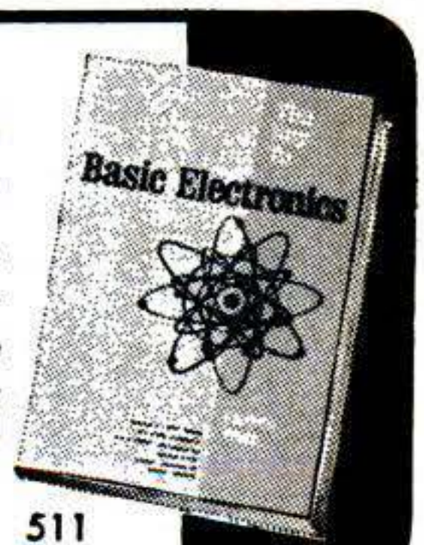


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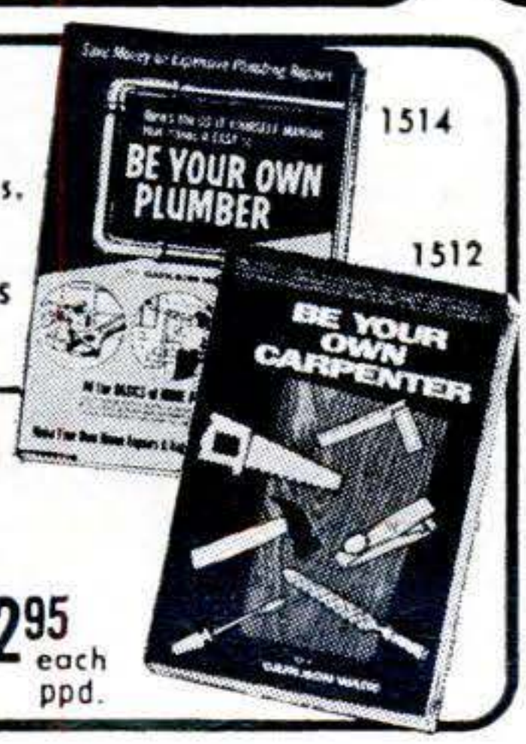


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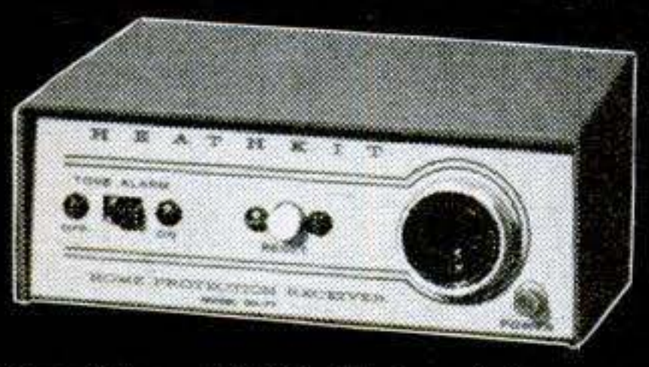

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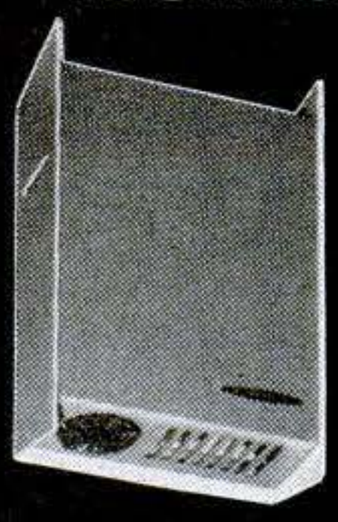

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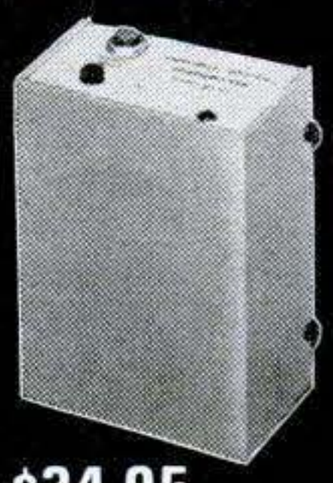

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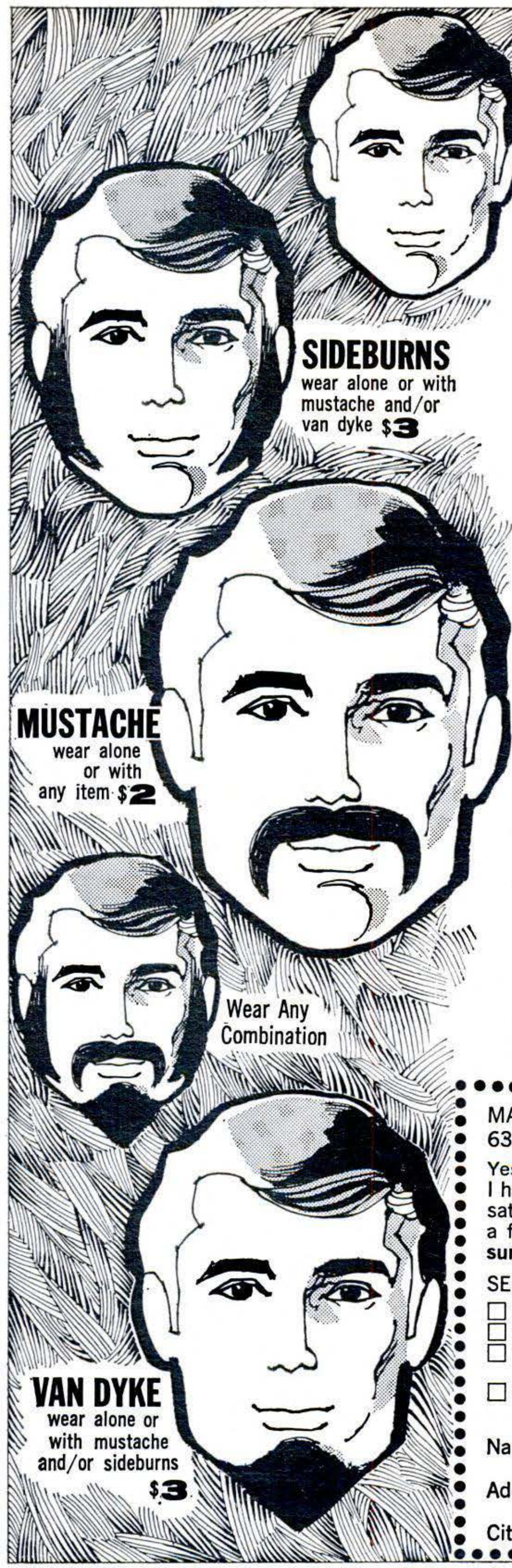


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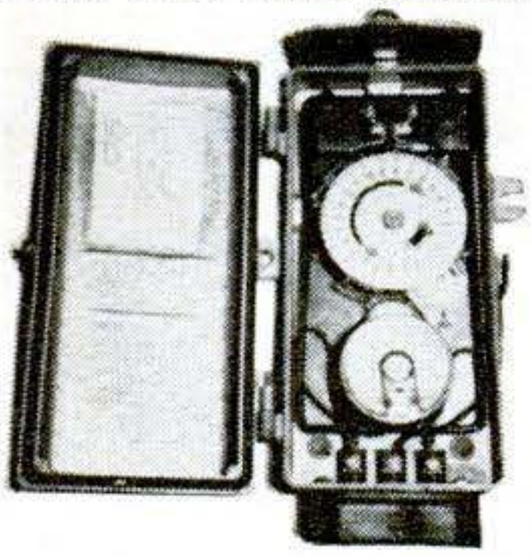

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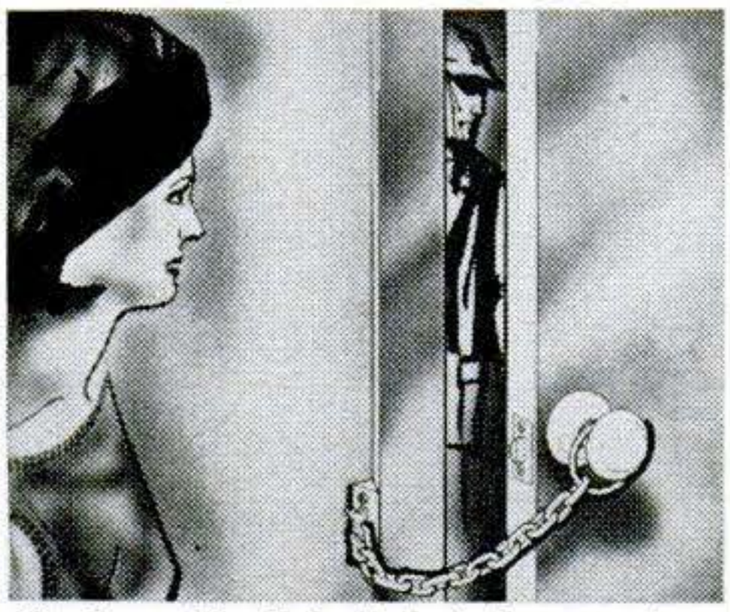

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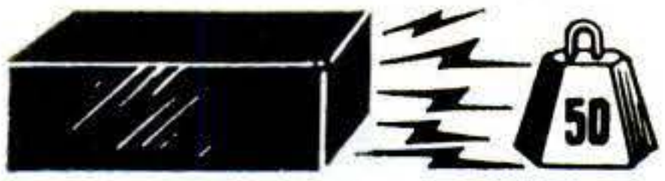


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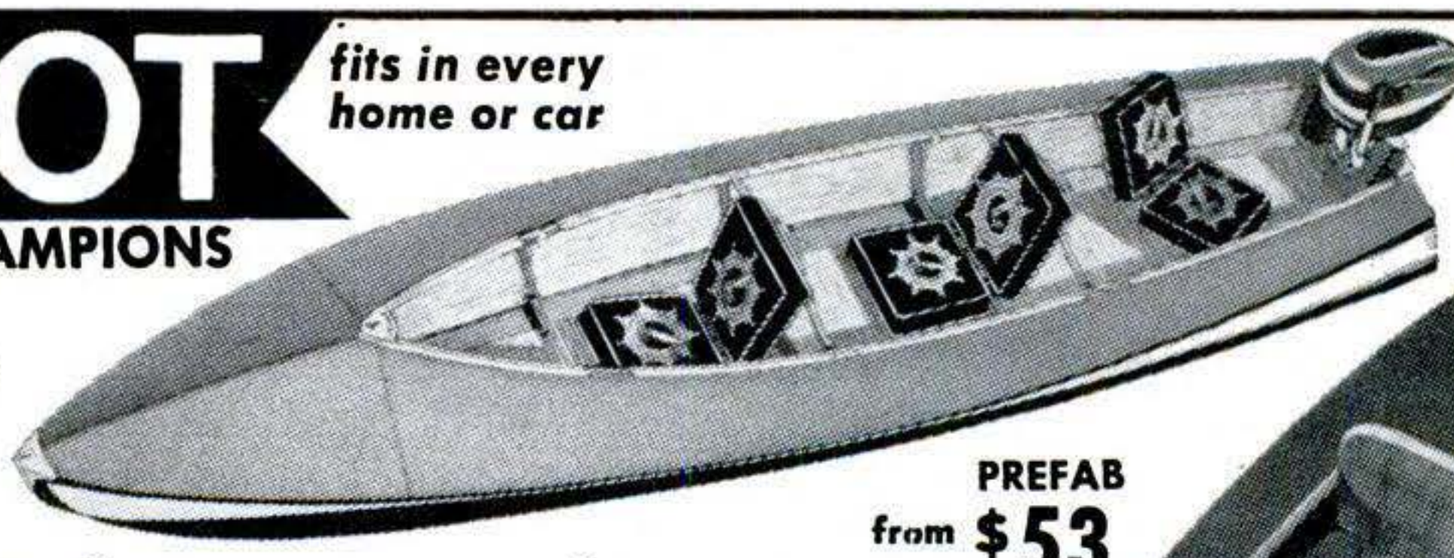

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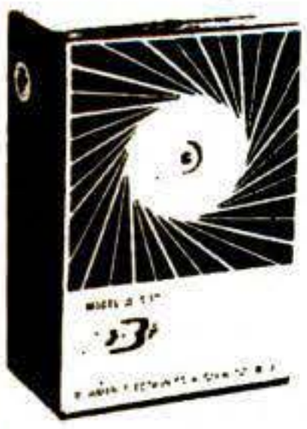

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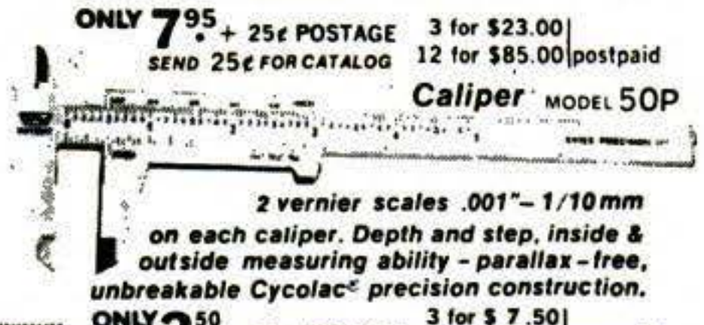

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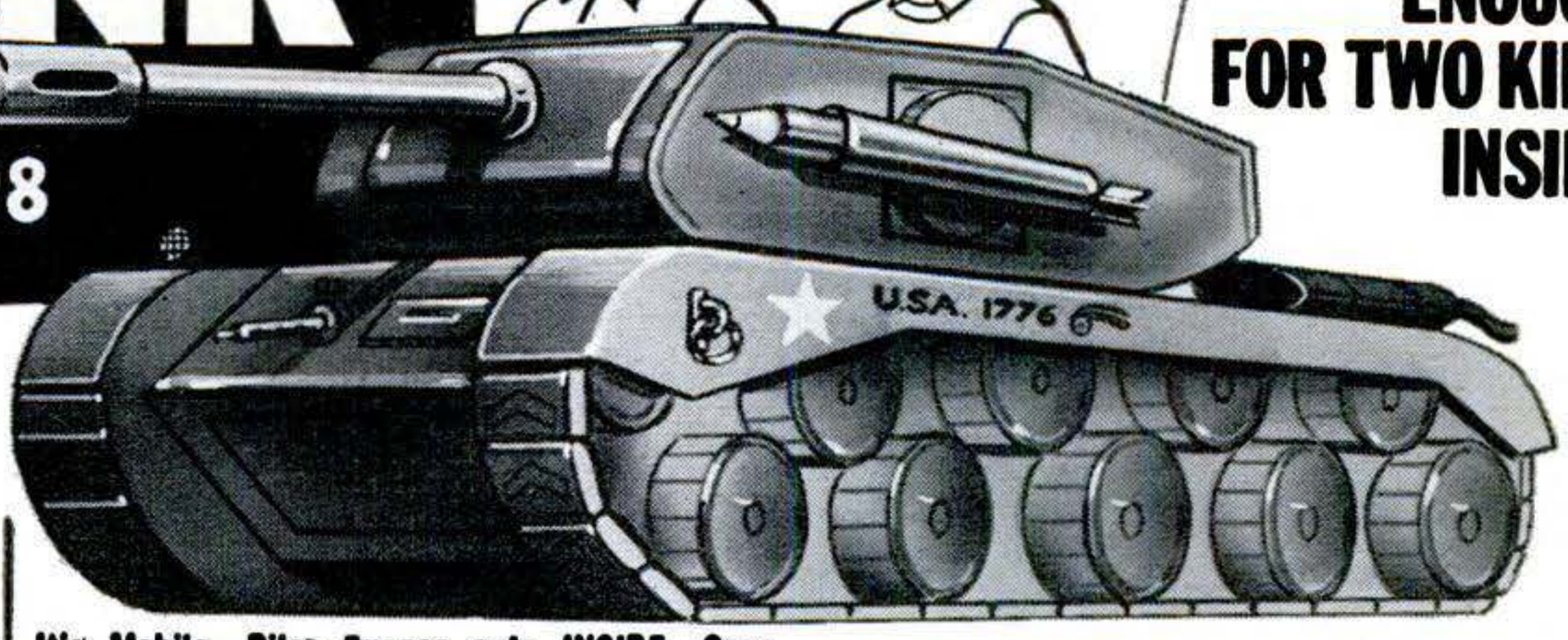


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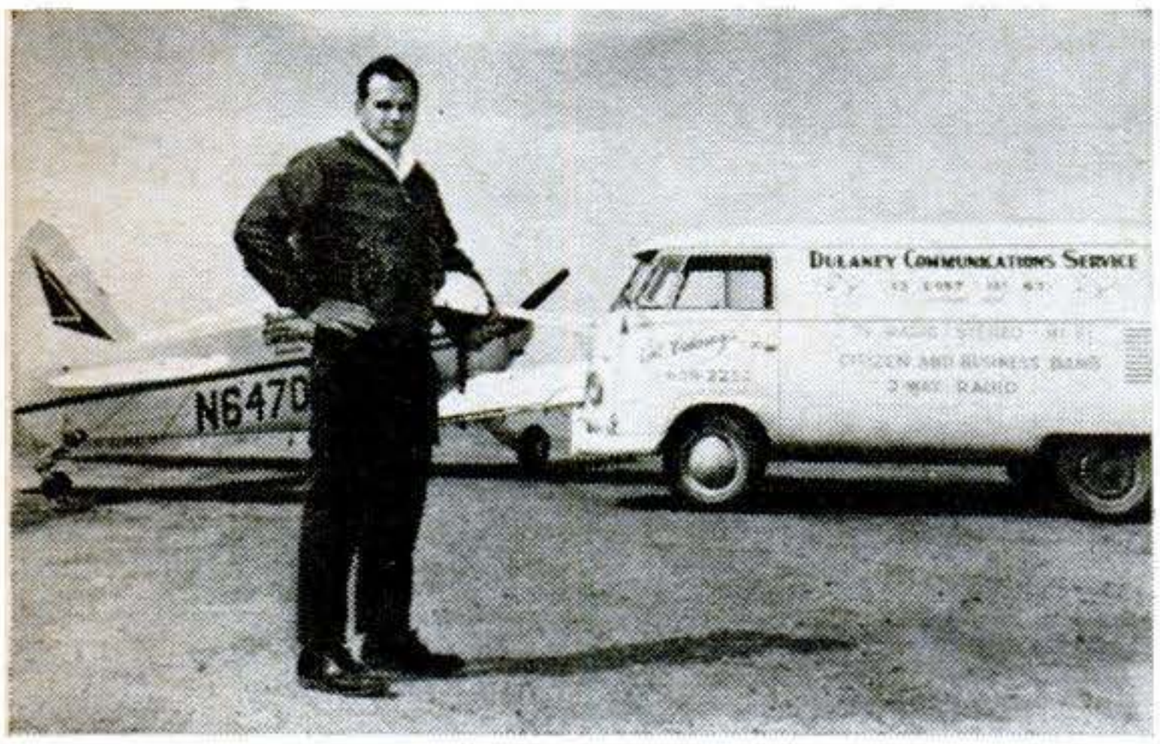


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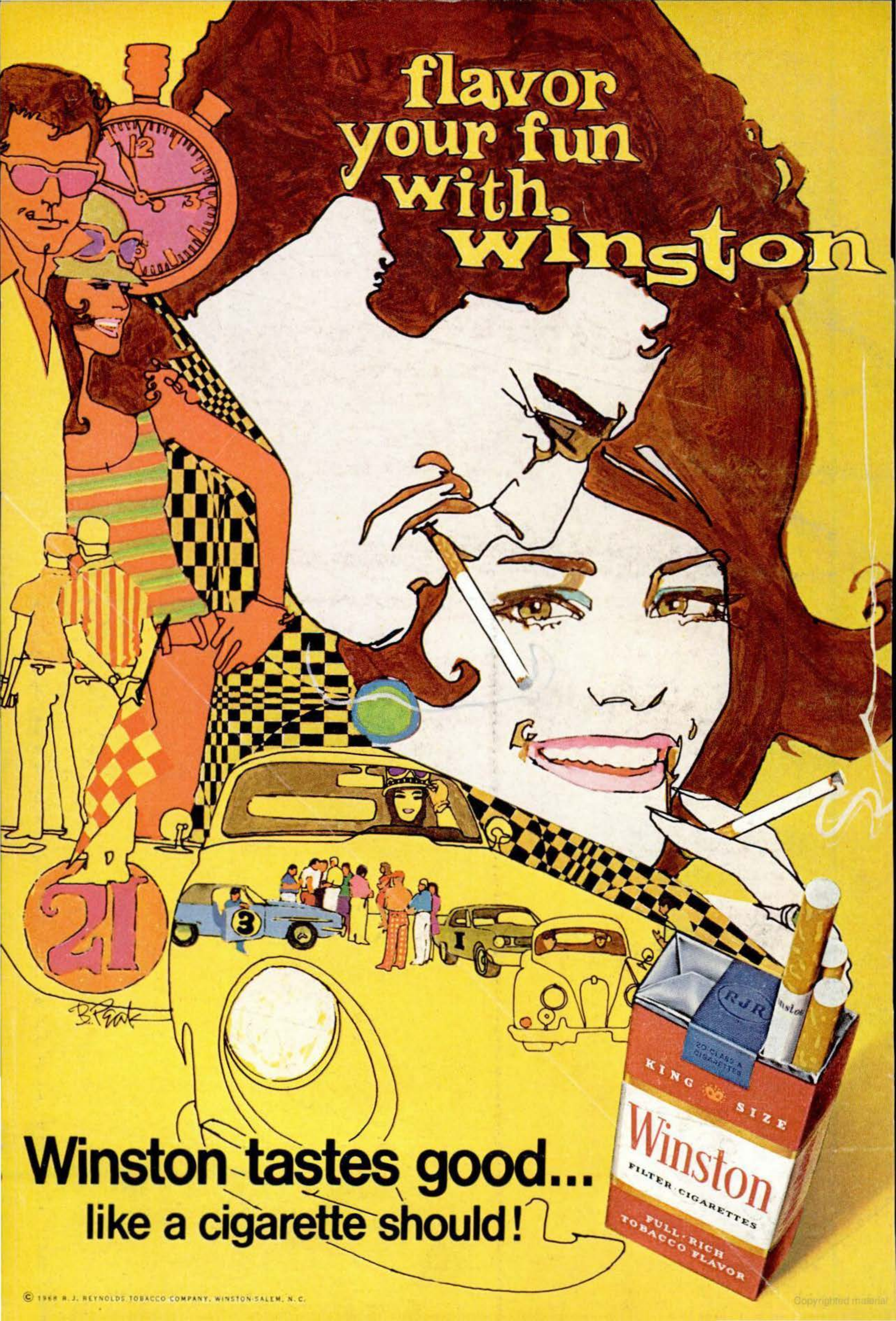


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